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Engineering News-Record

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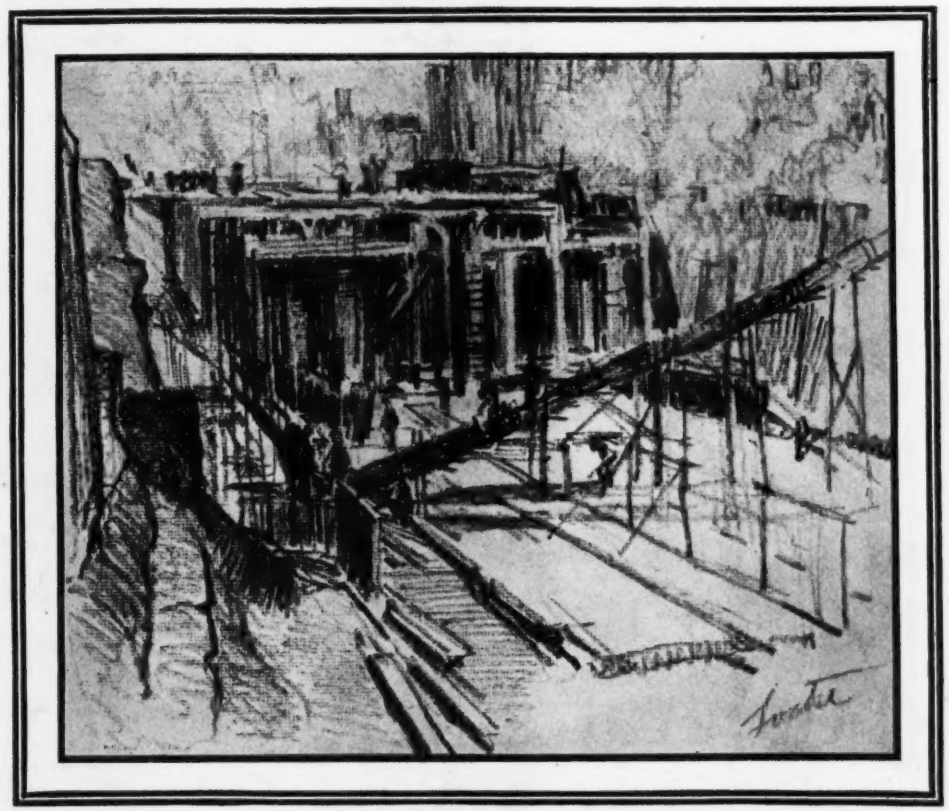

Building the Cincinnati Subway — *By Charles Locke*

Concrete Chuting Plants—Practical Hints on Erection, Operation and Maintenance

Cincinnati Builds Belt-Line Rapid Transit Railway

By Frank L. Raschig

Illinois Begins Traffic Endurance Test on Road with Many Different Types of Construction

By Clifford Older

Powder-Post Beetle Damage to Timber and Protection Against It

By A. D. Hopkins and T. E. Snyder

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

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Federal Sanitary Engineers

RECOGNITION of the value of the work of the sanitary engineers in the United States Public Health Service has been increasing in a gratifying way for several years past. A considerable number of such engineers are now employed in the Public Health Service. Some months ago their salaries and promotions were put on substantially the same basis as medical officers in the Public Health Service. What the sanitary engineers now lack to give them full recognition and status is being commissioned by the President the same as the medical officers. A bill to this end is now before Congress and is receiving a considerable measure of organized support from engineers, as stated in our news section this week. Engineering societies and individual engineers can render good service both to the public and the profession by backing this bill. Appeals to congressmen by engineers and local engineering societies in home districts would be of great assistance. The bill calls for no increased expenditures. It merely places the engineers in the Public Health Service on a par with the doctors.

Balloting on New Constitution

THERE is now in the hands of the corporate members of the American Society of Civil Engineers for ballot the proposed revised constitution. It is the outcome of more than two years of study and discussion and incorporates the essential demands of those who worked for a revision. The chief changes from the old constitution lie in giving to all of the country proportionate representation in the Board of Direction, in the distribution of the vice-presidencies by zones, in the restriction of voting for nominations to the members in the respective districts, and, finally, in giving a more definite status to the sections. Without a doubt experience will indicate desirable revisions in the new method of nomination, but, considering that this document has been evolved after so much study and discussion and meets long-standing demands in essential elements, it should be adopted by an overwhelming vote. Certainly the discussions at the last annual meeting and at the convention in Houston have exhausted the subject and have shown that for the well wishers of the society there is no alternative to approval of the constitution, thus clearing away discussion of administrative problems and allowing the society to resume its technical work.

Increased Individual Output

FEW better concrete examples of the economic advantage of high efficiency in pulling down inflated costs are offered than two which are noted in the news columns of a recent issue of *Automotive Industries*. The Willys-Overland Corporation at its Toledo plant is producing 50 more cars per day at the present time with 7,700 employees than it did a year ago with 13,000 employees. Employment records from the nine major rubber companies in Akron are to the effect that with a total force approximating 36 per cent of that of the 1920 peak 80 per cent of the peak production of 1920 is being recorded. In other words, during 1920 about 72,000 employees were working in these nine factories as against between 26,000 and 27,000 now, yet the present production is 80 per cent of that of 1920. It is not ordinarily easy for the layman to grasp the significance of the assertion that increased production will deflate prices, but the foregoing figures present in an indisputable and concrete way the value to general business of a high degree of efficiency. Undoubtedly other industries are increasing their per-man production, though exact figures are not so easily obtained. The instances cited are healthy indications that we are regaining our industrial balance.

In Aid of Vehicle Legislation

MOTOR-VEHICLE legislation is receiving in the aggregate a tremendous amount of study. The public manifests an interest equal to that of the highway engineer, the public official and the motor-vehicle manufacturer. Attempt at uniformity in legislation has been made through the work of the committee which drew up the proposed uniform motor-vehicle law. Yet uniformity and reasonableness are almost as far away now as when that excellent step was undertaken. We are certain, though, that the degree of lack of uniformity is not at all comprehended—even by highway officials. To get at the facts *Engineering News-Record* has spent much time in the preparation of an analysis of the subject. Every state motor-vehicle law has been studied and digested and the essential data thrown into a comprehensive table. This compilation is of unusual interest. The great value of the study, however, lies in the conclusions that have been drawn and that are presented in individual tables and graphs. Some of the results are truly astonishing. The analyses accompanying the big table and the conclusions are so clearly put that while having all of the thoroughness demanded by the engineer and the motor-vehicle manufacturer they are put in a way that will appeal to public officials and legislators as well. This study will appear in the issue of Sept. 1 and is here announced that there may be wide knowledge of it and the public benefit be thereby broadened.

Overwork and Underpay

ON RESIGNING after thirty years of engineering service for the District of Columbia, Asa E. Phillips submitted a letter to the engineer commissioner which is notable from several viewpoints: it outlines the nature and growth of the work of a municipal engineer who stood by a city for three decades; it illustrates the heavy burden carried by many engineers in public service because of insuf-

ficient technical staff; it adds another to the many instances of not merely overwork but also underpay of engineers in city, state and federal employ.

So far as he himself is concerned, Mr. Phillips says not a word as to underpay, but any one who knows Washington conditions, as regards both the district and the general government, need not be told that the salaries paid technical men of large experience and ability are far below their deserts and also far below the compensation of men occupying like positions in private service. What Mr. Phillips does urge is that for years past he has had to do, by his own hand, the designing of work costing millions of dollars; that salaries of assistant engineers have been so low that he has not been able to retain the services of men of high standing, and that draftsmen's pay is below that of day laborers. Although Mr. Phillips passes lightly over the condition of his health as a reason for resigning, it might readily be that his overburden has so undermined his strength as to make resignation imperative.

The incident affords another illustration of "the ingratitude of republics"—a phrase that applies to cities as well as states. But viewed broadly, the injury to the individual, in all these cases, fades into insignificance compared with the harm done to the public as a whole. When such things occur in federal jobs, a nation suffers. All of which points to the need of continuing with added vigor the efforts being made by individuals and societies to see that engineers in the public service are not underpaid—to which may be added attention to safeguards against overwork because of staffs inadequate in number or ability.

A Plea Based on Knowledge

WHEN an expert in an art complains of the imperfections of that art, his charges are not likely to be challenged, least so in the field of paint and painting, where every private citizen has had his fill of unsatisfactory experiences. Prof. Sabin, who holds a recognized position as paint expert, complains of the lack of knowledge in a specialized application of paint, namely the protection of wooden motor-truck wheels from the destructive effects of moisture changes. But the entire subject of the physical action of paint coatings is closely related to the specific case referred to, and is as much involved in ignorance. Nor is there any more knowledge on the chemical problems of paint, as in fact is directly suggested by a second case which Prof. Sabin cites to support his argument. In short, the entire field of paint bristles with unknown quantities. When it is considered that the annual paint consumption is over $300,000,000 in the United States alone—Prof. Sabin's estimate is inadequate by a third, we have reason to believe—the value of what might be accomplished by well-directed impartial research in this field may be appreciated. The plea for research, we think, deserves general support.

Among paint users there has always existed an undercurrent of belief that paint is a field of mystery, but that paint men know all about good paint and painting; and as a result of that belief, presumably, paint men have been reluctant to admit that they themselves were puzzled by many things in their field. Such a state of affairs was not favorable to cataloging a list of the unknown quantities and framing a research program.

Prof. Sabin has made a beginning in this task, however, and it should now be easy for others to come forward and tell what things are not known or need investigating. Such a general confession would be a significant piece of progress. It would remove one of our great industries from its state of medieval mystery and put it on a plane of scientific knowledge. Whether the research that is needed should be undertaken by the United States government, and whether the study of unknown questions at large is a proper federal function, is of course another question.

Corrosion of Reinforcement

THOSE familiar with the reinforced-concrete art of fifteen or sixteen years ago, when the Marlborough-Blenheim Hotel was built, may recall the wide interest aroused among concrete men by that undertaking, and correspondingly they will scrutinize most carefully the details of the small roof collapse investigated for *Engineering News-Record* by Lewis R. Ferguson. The case is of equal interest, however, to the entire structural engineering and architectural professions, since it is the first distinct case of a failure of reinforced concrete after the construction period, and because it thus presents anew in active form a question long ago laid on the table: whether reinforcing steel is subject to progressive corrosion. Fifteen years ago, not a few engineers shook their heads in doubt as to whether a reinforced-concrete building subject to sea-beach exposure would prove enduring. The Marlborough-Blenheim remained in satisfactory service, and other similar structures were built. Gradually, the old doubts were forgotten, but they will tend to be revived, now that a section of the roof slab has fallen.

On this score it is worth pointing out that the atmosphere of a kitchen in continuous service can hardly contain a measurable quantity of the salt spray and mist to which seashore corrosion is attributed; and in that event the present accident cannot be applied directly to the old problem. But with respect to the broader question of progressive deterioration, we have the fact that the collapse occurred under no momentary excess loading or other unusual condition, so that on the face of affairs it appears to be a clear case of progressive weakening of the slab. This impression is fully borne out by the details found by Mr. Ferguson on examining the wreckage. Corrosion of the reinforcement *did occur*, and it was the responsible cause of the collapse, Mr. Ferguson finds. Thus we are carried back to when the discovery of tension cracks in reinforced concrete was the sensation of the day in the concrete field, and when the possibility of rusting at these cracks was regarded by many as a crucial question. The question has long been considered to be laid to rest—largely by the unanswerable argument that no reinforced-concrete structure had ever failed, except during construction, and that the material is bound to grow stronger with age, not weaker. It is revived by the present collapse, which —despite the woful deficiency of steel and the very small section of the reinforcing wire, which would cause even a minute amount of corrosion to destroy the strength of the slab very rapidly—is a corrosion failure occurring after long service, the first case of the kind.

Fortunately we may feel sure that the resumed discussion of the problem will not be masked by the vague and aimless tone in which it was begun, for much has been learned about the quality and the behavior of concrete. Definite conclusions should be attainable.

The Illinois Paved Road Test

PAVED road testing on a stupendous scale is described by Clifford Older, state highway engineer of Illinois, on p. 274. Except possibly the tests of the U. S. Bureau of Public Roads, no experiments so numerous and of such variety have previously been attempted. The testing to destruction by truck traffic of full-size pavements is unique in highway experimentation. Involving an expenditure in excess of $300,000 this traffic endurance test alone is extraordinary. It is, however, but one of a number of kinds of field tests, some of them embracing hundreds of observations and all being checked by laboratory tests nearly duplicating in number the field observations.

Viewed by itself $300,000 seems a large amount of money to be consigned to purposes of experimental destruction. With $100,000,000 to be expended in a few years in roadbuilding, however, a third of one per cent is a small investment to learn how to build roads better even by a very little. And it is certain a great deal will be learned. Although results are barely mentioned by Mr. Older in his present article, because the observations have only begun to be analyzed, it is known that they are so significant that the prediction is freely made that new principles of pavement design will be the outcome.

Even should such a revolution fail to materialize, highway engineers cannot help gain increased understanding of subgrade action and of pavement-slab strength and endurance. This should put them a long way ahead of present practice.

Not only will Illinois obtain better paved roads because of these experiments but all roadbuilding in the country will be improved. This is the promise which makes the description of the Bates Test Road worth study although it merely states the task attempted. Information on the results obtained and their lessons to engineers will be given in succeeding articles.

Limitation of Professional Fees

IN PROFESSIONAL circles few incidents of recent years have been so significant as the decision of the board of trustees of Johns Hopkins Hospital that the maximum fee that should be charged for a surgical operation at their institution, no matter how wealthy the patient, should be $1,000, and that the physician's maximum charge for visits to the hospital should be $35 per week. Heretofore the medical profession's charges have been based on what the client could pay—particularly for surgical work. The structure is now rudely jarred. The directors of one of the foremost hospitals of the country, still conceding that there is good ground for the principle of charging what the traffic will bear, nevertheless declare for a limitation of that principle. In effect, also, they hold that there is a natural limitation to the value of the services of an individual.

While in the medical profession the Johns Hopkins step may be a shock, looked at broadly it is merely a recognition within the profession of a view widely held by the public. Question has often been raised as to the value of an individual's services. In some cases there is a ready monetary measure—as in business; in others, there is impossibility of relating the results to any material standard, as in teaching. It is to be expected, then, that the business man will, if successful, get a larger material reward for his efforts. "It is to be expected," we say, but it is not just nor beneficial to our national and social development. Witness the result in the wholesale desertion of their profession by brilliant teachers, and the consequent loss to the nation in the coming generation. But while the community *expects* to see the business man well rewarded it is by no means complacent with exorbitant emolument. Witness—whether it be a sound method or not—our income tax graduations, and the comments called forth by the payment to a steel corporation president of a bonus of $1,000,000 on a single year's operations. Nor do the comments come from radicals. They come rather from those who look beyond the present and count the loss to the public of false social standards, even though they are cognizant that under present standards the rewards are legitimate and that they are defensible on business grounds.

It is a far-cry from a steel president's bonus to large fees for surgical operations, but the hospital trustees' decision in the latter case is but the application of a principle that receives expression in the street's adverse criticism of the former. In both cases there is recognition of some natural limitation to the value of individual services.

It will be interesting to learn of the reaction in the medical profession. Viewed broadly, it is a desirable note in a time when we are sobering up from an era of too much emphasis on material returns from personal service.

Ideals for a Medical Career

WHEN the preceding comment on "Limitations of Professional Fees" was written there was no information at hand other than the restrictive decision of the hospital's trustees. Later, however, in a communication to the New York *Times* Dean Williams of the Johns Hopkins Medical School, with which the hospital is integrally connected, stated that the fundamental reason for the decision was the desire to impress upon medical students that their profession was of an altruistic nature and that they should think "as little as possible" of the financial returns. "Naturally," he says, "it is realized that the laborer is worthy of his hire, and that most students take up medicine for the purpose of earning a living, but at the same time it was felt that it was the educational duty of the institution to teach by precept and example that the ideal medical man is no respector of persons, and is justified only in looking forward to a relatively modest financial return, and should early learn that medicine is not a career for those who hope to become rich."

This, at first blush, would seem to put quite a different aspect on the decision. Yet we are not moved to change the comment of the preceding editorial. Whatever the conscious purposes, the other factors were probably unconsciously operative. In any event, the decision does have the tendency to set a limitation on the value of individual service and the decision will operate to strengthen that principle, even though that was not one of the conscious objects of the hospital's trustees.

In trying to impress upon medical students the proper ideals for a medical career the trustees deserve the public's thanks. Deterioration in the ideals of the professions has a serious influence on general social and business standards.

Cincinnati Builds Belt-Line Rapid-Transit Railway

Low-Cost Route Developed by Utilizing Old Canal Right-of-Way — Concrete Subway, Concrete Elevated Railway and Standard-Gage Surface Lines

By Frank L. Raschig
Assistant Chief Engineer, Cincinnati Rapid Transit Commission

A RAPID-TRANSIT railway remarkable for its low construction cost and for its unusual plant—a belt line surrounding the residential part of the city and traversing the heart of the business district—is under construction at Cincinnati, Ohio. Both the belt plan and the low cost are due in large part to the existance of the abandoned Miami & Erie Canal, whose right-of-way for city transportation purposes was granted by the state. However, independently of the existence of the canal, it is believed that the belt line is best suited to the conditions in Cincinnati and will prove influential in developing and guiding the future growth of the city.

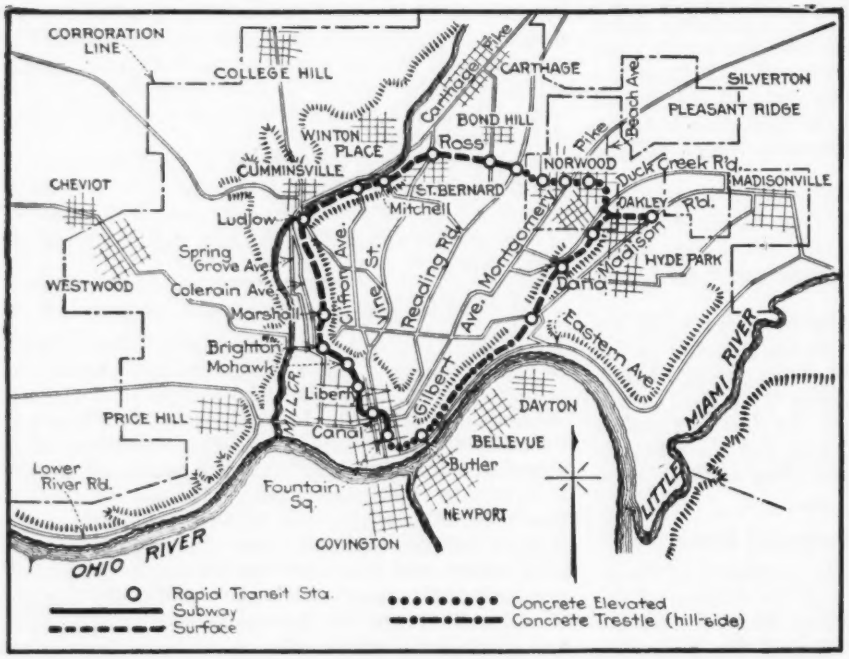


FIG. 1. BELT LINE RAPID-TRANSIT RAILWAY AT CINCINNATI

Construction is in progress on four sections of the subway portion of the line; two more sections may be placed under contract this year. By the end of 1923 about 11 miles of the system, which is 16½ miles long, will probably be ready for operation. In order to construct the remaining 5½ miles it will be necessary for the people to vote additional money.

Route and Mileage.—As indicated by the map, Fig. 1, the line begins at Fountain Square, and extends north in subway in Walnut St., to the canal and thence west in subway in the canal, or Central Parkway as it is now called to Plum St. The line in the Parkway is shown by Fig. 2. On this section and centering at about Race St. a combined rapid-transit and interurban terminal station, Fig. 3, will be located. At present only the center portion of the station, to be used as a combined interurban and rapid-transit station, will be built. If the station in the future becomes inadequate, the rapid-transit tracks will be put on the outside of the present structure, which will then be used exclusively as an interurban station.

From Canal and Plum Sts. the line extends north in subway to Brighton. From Brighton around the circle to the starting point, the line except for a short tunnel will be in the open, either of standard-gage surface construction or reinforced-concrete elevated railway. The map indicates the different types of structures. The total length of the loop is about 16.45 miles, consisting of 2.45 miles of subway; 9 miles in the open, with bridges or subways at intersecting streets; 0.2 miles of tunnel; 3.4 miles of concrete trestle, and 1.4 miles of concrete elevated structure.

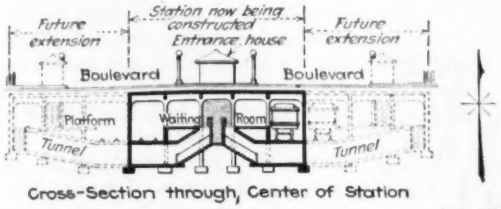
Topographical and Transit Conditions.— The original location of the city, and now the business portion, is a small plateau lying east of the mouth of Mill Creek. Above this plateau bluffs rise to a height of 300 ft. or more. Beyond the top of these bluffs the ground is very broken and undulating. Owing to this rugged topography, the avenues of easy entrance to the business section are limited in number. They have been preëmpted by the city street car lines. While these lines provide sufficient service for some of the territory within the loop, they are not available for rapid-transit lines to the suburbs. Also since the main business district of the city is at Fountain Square, almost the extreme end of the city, all traffic must traverse practically the entire city to reach this district.

The whole plan of rapid transit developed from an effort to pick up the interurban lines in the suburbs by a rapid-transit terminal system which would send the cars rapidly to the heart of the business section. As this problem was discussed and general plans made, it became evident that the local rapid-transit problem could not be solved by the solution of the interurban problem. In fact the local rapid-transit problem became eventually more important than the interurban problem. In the last few years nearly all the interurban lines entering Cincinnati have become bankrupt. Some have been discontinued and sold for junk. Others are in receivers' hands, and several that have been reorganized are awaiting the completion of the loop to get a better entrance into the city. One of the reasons, in fact the chief reason, that the interurban lines are in such poor condition is that they have not had an

entrance into the city which would insure rapid transit within the city limits. When the rapid-transit system is completed some of these interurban roads may be revived and reorganized.

The first plan worked out in detail provided that the interurbans should not enter the city but would merely touch the rapid-transit system; that is, the interurban cars would draw up to a platform at one of the stations and transfer passengers directly to the cars running on the loop. It was felt, however, that for some time the traffic on the loop would not be so great as to necessitate cutting off the interurban lines at the loop, and the plan was revised so that the interurban cars would come to the heart of the city over the loop until such time as local traffic would become so heavy that it would be necessary to restrict the loop to its service.

At first the topographic conditions of Cincinnati and its environs seemed to present a problem much more



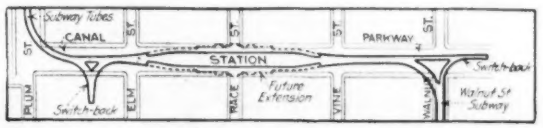


FIG. 2. CANAL STREET SECTION OF SUBWAY

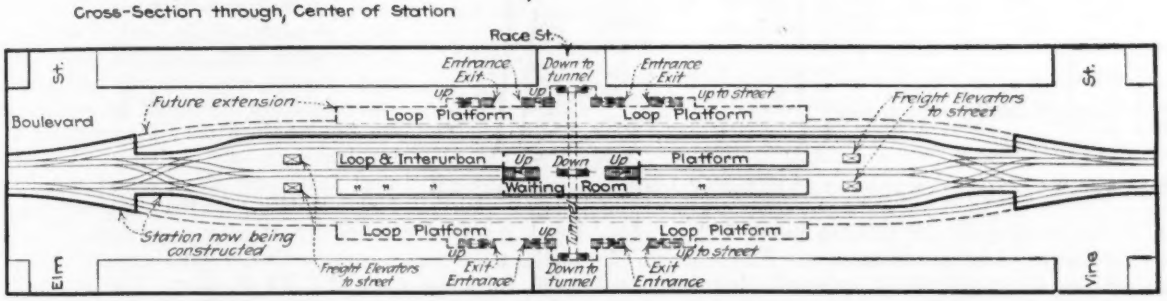


FIG. 3. RAPID-TRANSIT AND INTERURBAN TERMINAL AT RACE STREET

difficult of solution than would have been the case in more level cities such as Columbus, Indianapolis, and Chicago. But these very topographic difficulties have offered a natural plan which will give at once excellent interurban and suburban rapid-transit facilities, and this, too, at a comparatively low cost. In the first place the Miami & Erie Canal right-of-way already acquired by the city offers a direct and almost level entrance to the business district through thickly settled portions of the old city and the newer manufacturing and suburban districts, north and northwest; it provides an immediate north-and-south route for traction lines from the north; it offers an invitation for direct connection with the traction lines from the west at Brighton. In the second place, ravines, as for example at Torrence Road and Duck Creek Road, in which houses have not been built furnish what are in effect open cuts for ingress from the northeast. Third, there is a stretch of open country from Norwood to St. Bernard through Bond Hill which has been almost encircled by the city's growth northward and which will develop rapidly with proper transportation facilities.

To summarize, the conditions which seemed, upon superficial observation, to present unusual difficulties, in reality simplified the solution; for the right-of-way to be acquired is cheap, the streets to be crossed are few, there are few sewer and water pipes to be replaced (except on Walnut St. from Canal to Pearl St.), and a private right-of-way insuring speedy and direct entrance for interurban and suburban cars is easily obtainable. Finally, the line runs through the heart of the business district and should have the effect of spreading this district from the southern part of the city where it is now very congested. This is especially true on Canal St., where the combined interurban and loop station is located; this street, 150 ft. wide and twelve blocks long, is to be made into a wide boulevard and should develop rapidly.

Line and Station Structures.—The rapid-transit railway will be a double-track line of standard gage (4 ft. 8½ in.). The gage of the Cincinnati street railways is 5 ft. 2½ in., but due to complication produced by the use of two gages and the desirability of keeping surface cars (except fast suburban and interurban cars) out of the system only one gage is to be used. The maximum grade, except in one instance where a grade of 3.5 per cent is required, is 2 per cent. There will be no grade crossings; power will be transmitted from a third rail, and the cars will be designed to maintain a speed of 45 min. per hr. The capacity of the system at a 1-min. 9-sec. spacing of cars and with four-car trains is 110,000 people per hour. All the latest safety appliances are contemplated: block system, ventilating openings, emergency exits, separation of lighting and power ducts, and use of reinforced-concrete construction for all structures.

As indicated by Fig. 4, the subway portion of the system is a double-tube structure of reinforced concrete. Single-track tubes are used to get the piston action of the cars and thus secure better ventilation. The tubes are 13 ft. wide and have a clearance of 14 ft. 9 in. over top of rail. This height was adopted to admit standard freight cars, as it is possible that movement of freight may be permitted at night time.

It was determined to use reinforced-concrete structure, Fig. 5, for the elevated part of the line. Wherever the elevated lies on private right-of-way, a trestle form of construction, Fig. 6, will be used and especially on the hillside along Eastern Ave., where it is impossible to build on the surface due to the sliding nature

of the ground. In streets, the same longitudinal beam construction will be used as on the concrete trestle, but the beams will be supported by cross-girders and the girders by columns placed inside the curbs. The surface-line construction will be standard railroad construction using stone ballast and creosoted ties.

At all stations, except the station on Canal St., the platforms are being constructed to accommodate four-car trains, each car being 70 ft. long. The platforms will be at the height of the car floors. The stations will be equipped with all modern conveniences and the latest methods for handling passengers will be used. The station at Canal St. will be a combined interurban and rapid-transit station. The through tracks will be on the outside, while a third track from each end of the station, ending at the waiting room, will provide lay-over tracks for interurban cars. At each end of this station there will be Y tail-switching arrangements for the interurban cars.

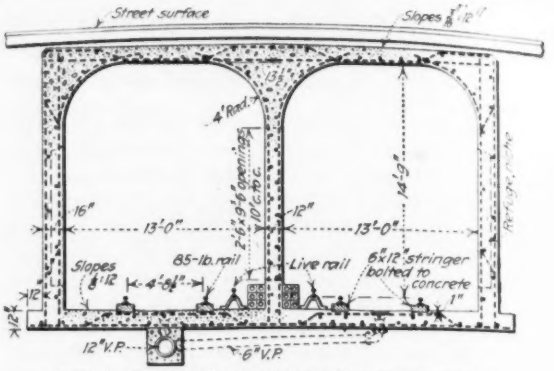
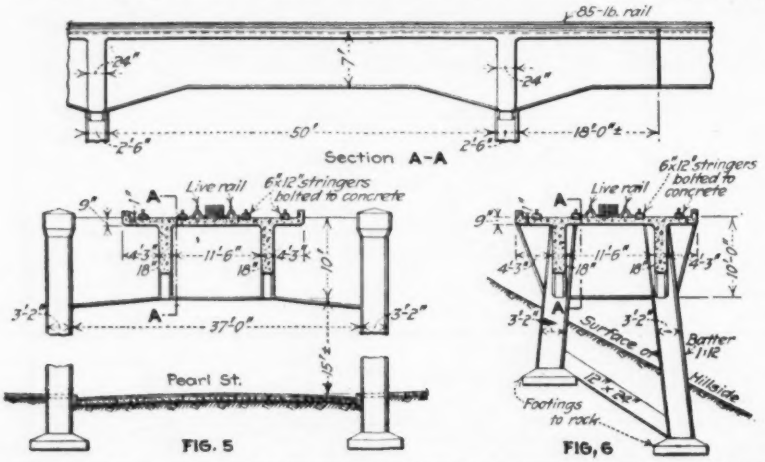


FIG. 4. DOUBLE-TUBE SUBWAY DOWNTOWN



FIGS. 5 AND 6. CONCRETE ELEVATED RAILWAY AND HILLSIDE TRESTLE

Construction Methods.—Construction presents no difficult problem. The structure is large but it is not complex, and the subway portion is constructed in open cut, without sheeting, in sandy loam and gravel carrying almost no water. Fig. 8 shows the old canal bed location, Fig. 9 shows the clean dry cut, and Fig. 7 shows the subway structure being built by chuting and wheeling from portable mixers on the bank. The floor is concreted first, then the wall and roof forms are erected and the superstructure concreted in sections. On two sections steel forms, shifted by travelers, are being used, and steel forms are also planned for the fourth section. On the other contract, wood forms supported by staging are used. Four sections are under construction, respectively 2,100 ft., 2,450 ft., 2,850 ft., and 2,260 ft. long. The contract prices are $524,000, $498,540, $556,905 and $493,094.

FIG. 7. DOUBLE-TUBE SUBWAY UNDER CONSTRUCTION

FIG. 8. OLD CANAL-BED RIGHT-OF-WAY

In the four sections there are about 350,000 cu.yd. of excavation and 58,400 cu.yd. of concrete with 3,000 tons of reinforcing steel. The contractor for Section 1 is D. P. Foley, Cincinnati; for Sections 2 and 3, Hickey Bros., Columbus; and for Section 4, Fred R. Jones Co., Chicago.

Cost and Operation.—The total estimated cost of the system in 1915 was $6,000,000 and this is the amount authorized for construction by vote in April, 1916. Due to intervention of the war and the higher cost of construction, this amount will not be sufficient to complete the system at the present time or in the near future, and it will be necessary to have the people authorize an additional bond issue of between $4,000,000 and $5,000,000. Until that time it is probable that a divergence may be made from Beech Ave. to Madison Road in Oakley. The portion of the line from this point to Canal and Walnut Sts. can be constructed for the $6,000,000 authorized. This is the most important part of the line and is about 11 miles of the total of 16.45 miles. It runs through the suburbs of Oakley, Norwood, Bond Hill, St. Bernard and Cumminsville and could be operated profitably before the entire system is completed.

Several years ago, the franchise of the local traction company was revised and included a provision for operating the loop. The courts, however, declared this franchise to be illegal. Due to the unsettled condition of traction matters in this city, the Board of Rapid Transit Commissioners has deemed it not advisable to take up the matter in definite form at present. Of course, the ideal method of operation would be to combine the rapid-transit system with the local street-railway system. By throwing as much traffic to the loop as possible, the street-railway traffic would be relieved, especially on long hauls to the suburbs, which are at present very unprofitable. By throwing most of the traffic from the suburbs into the loop there would be a saving in cost of operation to the surface system but there would also be a great saving of time to the people using the loop. The surface system should act as a feeder to the loop wherever possible, and as the loop encircles the entire city it would provide contact at all important transfer points, so that a great many surface lines running through the congested parts of the city could be cut off at the loop.

FIG. 9. OPEN-CUT EXCAVATION FOR SUBWAY

Portable Conveyor Fitted to Central Mixing Plant

BELT conveyors, 75 ft. long, constructed by adding 36 ft. of standard sections to each of two 39-ft. portable belt conveyors are operating successfully at the central mixing plant for the Mt. Vernon concrete road near Cedar Rapids, Iowa. The illustration shows the arrangement of the conveyors. They deliver into the sand and gravel bins from hoppers in the ground. Each hopper has a capacity of 6 cu.yd., and is charged directly by 3-yd. trucks hauling from the railway and also from adjacent stockpiles accumulated ahead of construction. A wagon loader at the stockpile loads into a truck with a dump body, and the truck takes the material to the hoppers. The 4-bag mixer is located under the bins and high enough to dump into other trucks which haul the wet batch an average of two miles to the subgrade. The contractor is the Henry W. Horst Co., Rock Island, Ill. The conveyors and loader were furnished by the Barber-Greene Co., Aurora, Ill.

BIN LOADERS MADE FROM BELT CONVEYORS

Alum in Illinois

Alum used at 22 of the water purification plants in Illinois during 1920 amounted to 2,300 tons, ranging from 5 tons at some of the smaller plants to about 780 tons at the largest plant. The cost ranged from $24 to $160 a ton. Analyses made at some of the plants show Al_2O_3, 17 to 17.25 per cent, insoluble matter 0.1 to 0.2 per cent, Fe, 0.5 to 0.75 per cent.

Features of San Francisco Bay Bridge Report

SINCE presentation of the report made by J. Vipond Davies and Ralph Modjeski to the general bridge committee of San Francisco, Alameda and San Mateo Counties, a joint conference committee, composed of representatives of various bay cities, and an engineering subcommittee have been meeting frequently and giving consideration to various phases of the project, including the exact location of terminals and approaches, the question of financing the $150,000 preliminary surveys and means of securing sanction from the War Department. A news note on the report appeared in *Engineering News-Record*, July 14, 1921, p. 81. The chief features are presented somewhat more in detail in the following abstract:

Any high bridge between Yerba Buena Island and San Francisco would naturally land on Telegragh Hill. It would not only involve very long and costly spans, even if piers were permitted in the channel, but would land the traffic in a section of the city already quite congested, and from which a proper distribution would be impracticable. Any tunnel on this location would have to be constructed at great depth in an unknown rock formation, as the water depth is too great for tunneling under air pressure, and the length would consequently be so great as to involve an extremely difficult problem in ventilation for vehicular traffic. We there fore consider this plan as impracticable. Any continuous tunnel across the bay, on any location, while practicable for purely electrically operated railroad traffic, would involve most serious ventilation problems for vehicular traffic, and enormous expense if constructed for all classes of traffic.

The location recommended as suitable and feasible for the crossing commences at any convenient point between Mission Rock and Potrero Point in San Francisco and extends thence due east to the line between the counties of San Francisco and Alameda, the location in the proposed naval base to be whatever would be satisfactory to the naval authorities. The committee believes that a highway connection with San Francisco would be of great value to the naval station.

The location in San Francisco was so selected that the through traffic will not add to, but will tend to relieve the traffic in the heavily congested streets and the distribution of rail and highway traffic can advantageously be arranged. Under no condition should the passengers from the rapid transit suburban traffic be discharged at the bridge terminals proper, but they should be carried beyond those points to more central distribution centers where connection could be made with existing systems of surface railroads. It is therefore recommended that the project be not considered solely a crossing of the bay alone but the extension of the railroad tracks either by subway or elevated structure to points of general distribution with a few well-located intermediate stations.

The air-line distance between the city halls of San Francisco and Oakland is approximately 8.13 miles while the driving distance between these two points via the location selected for the bridge is approximately 9.38 miles, so the deviation from the shortest distance is comparatively small.

Type of Structure

The width and capacity of the structure must be great to provide necessary roadway width, and consequently any high-level bridge with long spans would involve such enormous expense as to be economically prohibitive; and for the same reasons and on account of ventilation a very long tunnel for those classes of traffic is also impracticable. As all navigation is adjacent to the west shore of the bay, the location of the open channel at that point affords every facility for the passage of general traffic. The tunnel approach to this submerged or open-channel section would be such as to afford 40 ft. of water at low tide on the pierhead line, maintaining this depth for a distance of 1,500 ft.; rising thence to a water depth of 20 ft. at the far side of a 2,500-ft. open channel beyond which the tunnels rise above the level of the water and cross on bridge and fill to the Alameda shore. Under this plan the entire deep-water portion of the bay south of the bridge location could be used without interference and to its absolute limit of capacity for fleet or commercial uses.

Traffic

Although separate in political entities, the population around San Francisco Bay is unquestionably one in its interest. The exact distribution of its population is immaterial to this project. The important aspect is that there is in the district tributary to the bridge approximately one million persons. The present vehicular traffic carried on ferries, amounting to about 725,000 vehicles last year, appears to be no criterion as to what may be anticipated if a suitable bridge is provided.

The two classes of transportation to be provided for of the most vital importance to the population on both sides of the bay are the suburban passenger and vehicular traffic. The present total passenger ferriage appears to be in excess of 40,000,000 per annum and increasing. If the prosposed structure is built, however, it is most unlikely that all the traffic would be diverted from the present route, so that allowing for increase in the growth and the better service rendered and for the diversion of the greater proportion, it is probable that not over 50,000,000 passengers per annum would use the new route for many years to come.

Allowing an operating speed of 10 miles per hour, a single 20-ft. roadway in both directions would permit passage of mixed motor vehicles at the rate of 1,260 per hour, 15,400 per day, or, approximately 5,250,000 per year. For crossing the open channel in tunnel the single 20-ft. roadway for vehicular traffic would be adequate for the business offered for a good many years, particularly as the length from grade point to grade point would be only approximately 1¼ miles. The bridge trestle and fill on the remainder of the crossing should be made in the first instance the full width of 40 ft. and when the point of actual design of the structure is reached, arrangements should be made so as to permit, in the future, a second vehicular tunnel being built under the waterway gap. This is advisable in keeping the initial cost down to a minimum. The open channel or tunnel section constitutes the greatest element of expense in the project.

Further Details Needed

Pending more accurate data on the bay bottom it cannot be stated definitely whether the tunnel section should be constructed as a shield-driven steel tube lined with reinforced concrete, or as a box type of structure sunk in sections in a previously excavated trench. Either method of construction should provide for two railroad tunnels of size large enough for all classes of railroad equipment and one vehicle tunnel with a roadway width of 20 ft. between curbs. The transverse application of ventilation should be used; that is, fresh air should be blown in at roadway level all along the tunnel section and foul air removed through continuous openings at the roof, or the reverse.

The further investigations necessary will require triangulation surveys and borings, both ashore and at numerous points across the bay, after which it would be possible to prepare specifications and working plans upon which bids could be called for. All of the further surveys, borings and studies necessary could be made for an amount probably less than $150,000, and could be completed in a period of about eight months.

Justification for the Project

A study of traffic figures and cost estimates leads to the conclusion that this project would likely not yield net returns during the early years of operation fully equal to the amount of the fixed charges on the investment; nevertheless it appears reasonably certain that after those early lean years the communities will obtain full returns either from adequate toll charges or by general advantage accruing from reduction in the toll charges. There can be little doubt

that the completion of the work contemplated will tend to closer relations and interchange and consequently to the more uniform growth and development of the metropolitan district as a whole.

The total cost of the project is estimated at $40,000,000. The fixed charges at 6 per cent would be $2,400,000; maintenance, depreciation, etc., would involve an aggregate annual charge of $650,000. The net earnings necessary to pay full interest charges on bonded capital would be $3,050,000 per annum. Gross earnings in the first year after completion are estimated at $1,592,500, increasing steadily until, in the fifth year, the earnings would be $3,630,000 per annum.

The recommendation is that whether the project is financed by private enterprise and private capital or not, it should, without question, be ultimately acquired, owned and controlled by the people of the bay cities.

Some Paint Definitions

DEFINITIONS of some basic terms used in connection with paints and varnishes reported by the committee on Preservative Coatings for Structural Materials of the American Society for Testing Materials were as follows:

Size.—In the painting art a size is a liquid material, the principal vehicle of which is water, and one which contains as a necessary ingredient a fairly large proportion of water soluble binder with or without pigment. A size is used to prepare a surface for further treatment and is not regarded as a finishing material.

Varnish—A liquid coating material, containing no pigment, which flows out to a smooth coat when applied, and dries to a smooth glossy, relatively hard, permanent solid when exposed to the air in thin films.

(Some varnish, while possessing the other characteristics, dries without the usual gloss. Such varnish is usually called "flat varnish.")

Enamel—A special form of paint which, when spread in a thin film, flows out to a smooth coat and dries to a smooth, glossy, relatively hard, permanent solid when exposed to the air. An enamel always contains pigment and has considerable hiding power and color. Some enamels dry to a flat or eggshell finish instead of a gloss finish.

Filler—A special kind of paint designed to be used for filling pores or other small breaks in the continuity of a surface preparatory to further treatment. When applied and exposed to the air, a filler should dry to a relatively hard, permanent, solid capable of properly supporting subsequent coats.

Toner—An organic pigment which does not contain inorganic pigment or an inorganic carrying base.

Lake—A special type of pigment consisting essentially of an organic soluble coloring matter combined more or less definitely with an inorganic base or carrier, both together forming an insoluble pigment characterized generally by a bright color and a more or less pronounced translucency when made into an oil paint.

(A more specific definition requires more extended description of the two and perhaps three types of pigment now generally classified as lakes. It would include (*a*) the older original type composed of hydrate of alumina dyed with a solution of the natural organic color, and (*b*) the more modern and far more extensive type made by precipitating from solution various coal tar colors by means of a metallic salt, tannin, or other suitable reagent, upon a base or carrier either previously prepared or coincidentally formed. A number of lakes, combining both types in varying degree, might be regarded as a third class.)

Drying Oil—One which possesses to a marked degree the property of readily taking up oxygen from the air and changing to a relatively hard, tough, elastic substance when exposed to the air in thin films.

Semi-Drying Oil—A semi-drying oil possesses the characteristics of a drying oil but to a lesser degree. There is no definite line of demarcation between drying and semi-drying oils.

Non-Drying Oils—A non-drying oil does not of itself possess to a perceptible degree the power to take up oxygen from the air and lose its liquid characteristics.

Powder-Post Damage to Timber and Wood Products

Burrowing Grubs Reduce Wood to Powder—Remedy and Prevention—Structural Timber and Manufactures Attacked

By A. D. Hopkins and T. E. Snyder

Bureau of Entomology, U. S. Department of Agriculture

EXTENSIVE injury to seasoned hardwood material of all kinds, finished and unfinished, is caused by grubs which are the larvae or young of small beetles known as powder-post beetles. These grubs, yellowish-white in color and from ⅛ to ¼-in. long, burrow through the wood in all directions and convert it into powder, finally boring to the surface for the escape of the beetles. Damage of this kind is distributed widely throughout the world, many species of these beetles being carried from one country to another in the commercial products which they infect. To prevent infection of this kind and to check further damage in infected timber are two important points in the economics of the timber industry.

This powder posting damage to lumber is fairly well known in the lumber industry and we have received

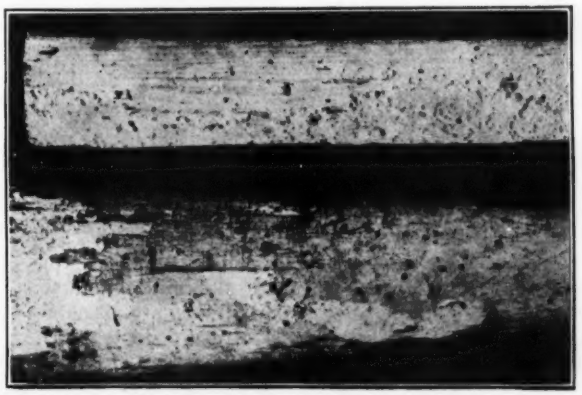


FIG. 1. INFESTED IMPLEMENT HANDLES

during this fiscal year over 40 requests for information on prevention and remedy of this damage to both crude and manufactured seasoned wood products, including woodwork of buildings. Some of these cases were important, the injury being done to stored material of the army and navy and the Aircraft Board. It is not generally realized, however, that much of the damage can be prevented by the adoption of a system of inspection, classification and prompt utilization, such as is noted later in regard to methods of control.

Infested wood may be detected by the fine powder found on or beneath piled products of seasoned hardwood. During the first year of attack the powder comes from exceedingly minute holes, but after the second year the small holes from which the beetles have emerged are more or less conspicuous (See Fig. 1). When the wood is cut or split the interior may be found converted into a mass of closely packed powdery material which has been held together by an outer thin shell and intervening fibers of sound wood. The grubs burrow in all directions and pack their burrows with the pulverized wood. The white ash board shown in Fig. 2 is from a closely piled stack of shipbuilding lumber through which the larvae had burrowed.

Seasoned heartwood and sapwood of both hardwood and softwood trees are attached by different kinds of

these beetles, but by far the larger proportion of this kind of trouble is caused to the seasoned sapwood of hardwood by species of the genus Lyctus. Second growth sapwood of the best quality which has seasoned for a year or more and has been stored in one place for two years or more is specially liable to attack, the loss amounting sometimes to from 10 to 20 per cent of stored material which has been neglected. Seasoned wood is attacked because the chemical changes in the process of seasoning render the nutritive substances, such as sugar and starch, especially suitable as food for the grubs. Wood seasoned for less than eight to ten months will not be attacked. With beetles of the genus Lyctus, the burrowing is confined to the sap-

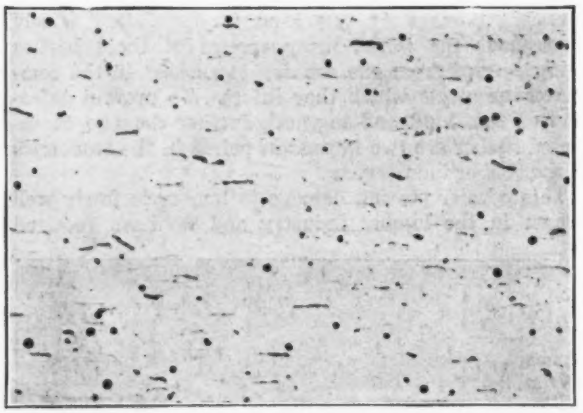


FIG. 2. POWDER-POSTED WHITE ASH SHOWING BURROWS OF LARVAE AND EXIT HOLES OF BEETLES

wood, except that the heartwood is sometimes penetrated when the mature beetles are emerging.

Structural timbers, car and shipbuilding lumber, veneer and plywood for airplanes, farming machinery and wheel stock, tool handles, furniture, flooring, interior finish and ornamental woodwork are among the articles affected. Hickory, ash and oak are the most liable to injury, but other woods attacked include osage orange, black walnut, butternut, maple, elm, locust, poplar, sycamore, eucalyptus and bamboo. On the other hand, chestnut and dogwood appear to be immune. As the wood is not attacked until after it has seasoned for a year or more the loss due to the "powder post" injury does not affect the producer but falls upon the dealer, manufacturer and consumer. Quartered-oak flooring is frequently infested and there may be controversy between the manufacturer and the builder as to whether the wood was infested before or after being laid.

Habits of Powder-Post Beetles.—The Lyctus beetles are small, slender, somewhat flat and from brownish to nearly black in color. Upon emerging from the wood they fly or crawl about in search of suitable material in which to deposit their eggs, the eggs being deposited by the female soon after its emergence from the wood. Each female deposits many eggs from which the larvae or white worms are hatched, and the burrowing of these numerous worms in quest of food results in the complete destruction of the interior wood fiber. After the continual attacks from successive generations nothing will be left but a thin outer shell.

Infestation of wood stored in cold places may escape notice, since at low temperatures the larvæ are dormant, but they become active when the wood is removed to the dry kiln or other warm place. At Washington, D. C., the beetles are active or flying from about March 1 to July 31, but the period varies with the species of insect, the temperature of the storerooms and the geographical location.

Methods of Control

Prevention of the injury and loss caused by these insects includes the destruction of the insects in infected timber and the prevention of attack in clean timber.

Reclaiming Infested Wood.—All infested material, including sap edges of lumber, and all refuse sapwood in which the insects might breed, should be sorted out and disposed of by burning or otherwise. Material showing the slightest evidence of powder-post damage should be destroyed, except possibly such articles as may be tested for the required strength and found to be of sufficient value for use after treatment. In partially damaged material, such as the sap edges of lumber and parts too valuable to be destroyed, the infested parts should be cut away and burned.

This work should be done between October and March in storehouses and before April in the open air. If it is done thoroughly and supplemented by annual inspection, it will eliminate the trouble, unless there is a continued introduction in lumber and material received. To avoid such new infection all material should be carefully inspected before shipment, or at least before it is placed in the yards or storehouses.

For the more valuable stock, or where it is not practicable to remove the infested parts, the wood should be treated for the destruction of the insects between October and March. The objection to treatment is that wood once infested may be so damaged as to be unsafe for use. Pure kerosene oil may be applied liberally with a brush or saturated rag, or the wood may be immersed in kerosene. The only objection is the fire risk, but as kerosene soon evaporates the treated material is not long near the danger point. Kerosene does not affect the application of shellac or varnish, but makes it more difficult to stain treated sapwood to match the rest. Hot mixtures of creosote and kerosene oil 3 to 1 (or 1 to 3 for deeper penetration) and 1 to 3 creosote and naphtha have been used successfully, applied by immersion or brushing.

Thorough steaming of the infested wood in the dry kiln is effective, the seasoned wood being heated to temperatures up to 200 deg. F. for a short period after the usual kiln drying operation. As steaming under pressure weakens and discolors the wood, it should not be applied where fine finish or great strength are required. Fumigation of infested wood with sulphur fumes in tightly closed drying rooms at the time of the emergence of the beetles is recommended only for killing the beetles and preventing egg laying.

In the case of powder-post damage to the woodwork of buildings, a prompt examination should be made. When it has been determined where the insects are burrowing, the wood may be drenched with kerosene oil, using a saturated rag, care being taken that the work is not done near a fire. Several applications of oil may be necessary and careful watch should be made after the treatment to determine whether it has been successful. If the borers are too deep or if the wood is structurally weakened or rendered unsightly, it should be replaced with heartwood or softwood.

A system of inspection, classification and prompt utilization of timber is really more important than

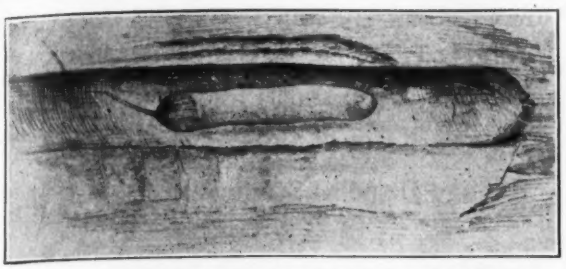


FIG. 3. EGG OF LYCTUS BEETLE IN PORE OF WOOD (HIGHLY MAGNIFIED)

chemical treatment alone, since by proper methods of management it enables large manufacturers and lumber companies to keep their yards free from this pest. The instructions given in the pamphlet on these insects, issued by the U. S. Department of Agriculture, are as follows:

Inspect material in yards and storehouses annually, preferably in November and February, and sort out and burn material showing evidence of powder post. Burn all refuse and useless sapwood material.

Classify seasoned hardwood stock into: (A) hickory, ash, oak, etc.; (B) heartwood, pure sapwood, and part sapwood; and (C) according to the number of years seasoned.

Utilize or sell oldest stock first. Inspect all new stock to prevent introduction of powder-posted material. Use only heartwood piling sticks in lumber piles.

To prevent attack treat the more valuable material, between October and March, with boiled linseed oil. Varnish or paraffin the sapwood portions of backs and interior surfaces of cabinet work, inside finish, and furniture.

Preventive Measures—Stock which has been seasoned longer than eight months and is to be held in storage, may be rendered immune by applying two coats of hot boiled linseed oil, or immersing it in hot oil. This treatment should be given between October and March. The boiled oil will dry more rapidly than raw linseed oil, especially if kerosene is added to the hot oil. Linseed oil has an advantage in that it can be applied profitably to unseasoned timber, since it will prevent checking in seasoning. It stains the wood slightly yellow. Creosote can be used effectively when the brown stain will not be detrimental. The hot creosote should be applied by dipping or brushing. For finished products, any substance which closes the pores of the wood may be applied, such as varnish or paraffin wax, to prevent the beetles from depositing the eggs in these pores.

The use of chemicals for the prevention of the damage is based on the recent discovery that the eggs are hidden within the pores of the wood. Fig. 3 is a highly magnified view of the egg in a pore of wood on radial section of ash stock for ladder rungs. Although the insects and their damage to lumber have been known for many years it is only recently that the peculiar egg of Lyctus was discovered.

Transport Minister's Power Under Roads Act

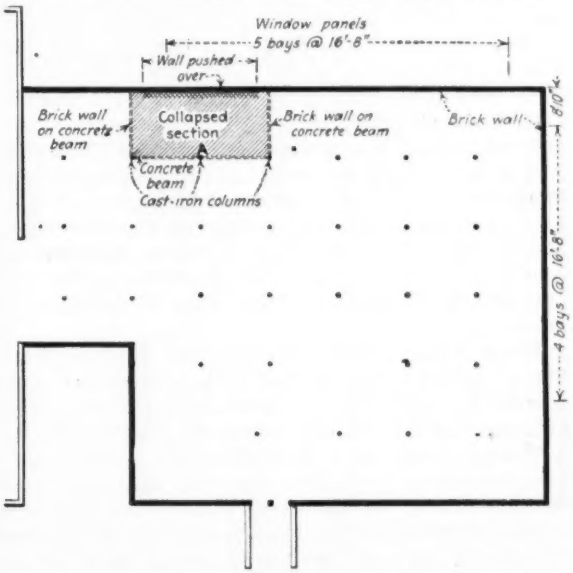
Though this regulation has not yet been enforced, under the Roads Act of 1920, the British Minister of Transport is empowered to prohibit the use of any specific type of vehicle on any particular highway if that class of vehicle cannot be driven on that highway without endangering the public or the occupants of the vehicle, or if the highway is considered unsuitable for such a type. It is considered unlikely that this power will be invoked in London or any other large cities

Small Concrete Roof-Slab Failure in Seashore Hotel

Reinforcing Wires at Break Weakened by Corrosion by Intrusion of Moisture Through Bottom of Slab

By Lewis R. Ferguson
of Wig, Hollister & Ferguson, Engineers, Philadelphia

FAILURE of a small section of reinforced-concrete roof over the kitchen annex of the Marlborough-Blenheim Hotel at Atlantic City, N. J., on Aug. 9, is of exceptional interest because corrosion of the reinforcing mesh appears to be responsible. This concrete hotel, built about 15 years ago, was one of the first, if not the first, structure of its kind erected along the sea coast. Exhaustive investigations made by R. J. Wig and the writer a few years ago to determine the effect of sea water upon concrete, subsequently described in a series of articles in *Engineering News-Record*, led to the conclusion that steel embedded in good



LOCATION OF COLLAPSE, HOTEL KITCHEN ANNEX

concrete, even to a considerable depth, is subject to corrosion above the water line when subjected to moist sea air. It was found that the rapidity of corrosion, with resulting cracking of the concrete member, was apparently governed by a number of conditions, but that the seriousness of the situation should be recognized by engineers who are entrusted with the design of concrete structures near our sea coasts. While the condition of many reinforced wharves, piers and bridges was described in support of the theory advanced, as far as the authors could learn no enclosed reinforced-concrete building exhibited signs of corroding reinforcing in its interior members. It is for this reason the failure of the reinforced roof slab of the Marlborough-Blenheim is worthy of unusual study.

The roof, a section of which collapsed suddenly, without any warning, shortly after 1 p.m. on August 9, covered a two-story annex used as a kitchen, pantry and storeroom. Both floors of this annex are of concrete, the first resting directly on the sand and the second being a reinforced slab in which hollow terracotta tile were embedded; the roof is also of concrete. A sketch herewith indicates the extent of the collapse.

The collapsed section of slab was supported on one side by a concrete beam and on the other side by a 9-in. brick wall, about 15 ft. apart in the clear, while the ends were supported upon brick walls resting upon concrete beams, about 33 ft. apart. The slab, 8 in. thick, was of cinder concrete of good quality, and the upper surface was covered with a bituminous coating for waterproofing purposes. Over a part of the collapsed section a granolithic walkway had been laid. The reinforcing consisted of galvanized wire mesh of about 0.105 in. diameter, whose wires were spaced 5 in. apart one way, and 4 in. apart the other; the wires of 4 in. spacing apparently spanned the short way of the slab. These wires were embedded variable depths in the concrete; in some cases the covering was over 1 in. thick, but in other places the wires were less than ½ in. from the bottom of the slab. There was no other reinforcement.

Evidently the slab collapsed through the formation of a longitudinal crack near the center, for a section about one-half as wide as the slab seems to have swung down toward the inside of the building; it broke away and came to rest in an inclined position against the cast-iron column marked "A" in the sketch. The wire reinforcing strands protruding from the lower edge of this section resting on the floor, are near the surface and many of them are badly corroded; they have the appearance of having failed from diminution of cross-section. Other reinforcing wires, near those found corroded, exhibited all the signs of normal failure under tension. They are slightly necked down and the fracture is cupped. Evidently they were subjected to excessive tension.

When the slab collapsed the outside brick wall was pushed out and fell, together with a considerable portion of the roof, into the court below; there was no evidence that the wall was responsible for the failure.

The surprising thing about this roof is that it stood for 15 years without any evidence of weakness. From dead load alone the reinforcing wires were subjected to a stress which, according to our present knowledge, was beyond the limit of safety (figured on 15 ft. simple span, with dead load taken at only 60 lb. per sq.ft., the unit-stress would appear to exceed 100,000 lb. per sq.in.!). Since this building was erected we have learned much about reinforced concrete. An examination of the edge of the slab where apparently the first break occurred shows that the rusting of the reinforcing at this point was caused by the intrusion of moisture through the under side of the slab. When this corrosion decreased the strength of the wires to a sufficient extent they broke; adjacent wires were called upon to bear an additional load they were unable to sustain, they failed, and the section collapsed.

Failure was caused primarily by the corrosion of the reinforcing of the slab. The collapse was hastened by the lack of adequate reinforcing and the nearness of the metal to the surface of the slab.

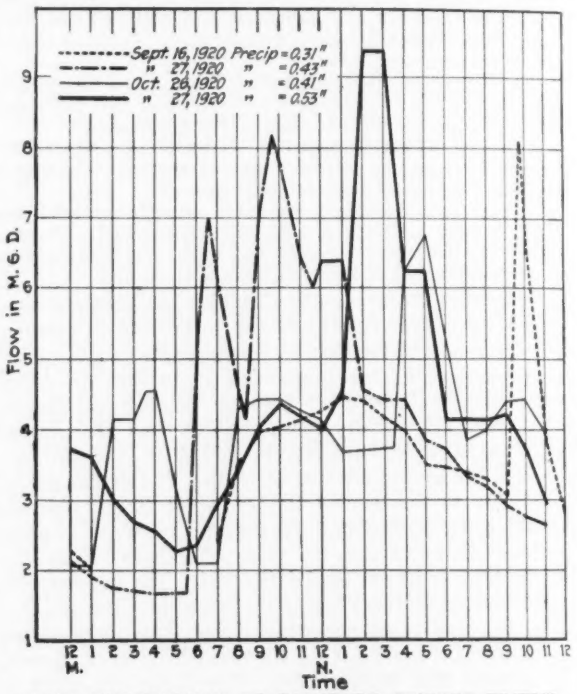
We are still in the dark as to the condition of well reinforced enclosed concrete buildings along our sea coasts, for this concrete slab that failed certainly cannot be considered typical. Some incidental but very interesting evidence of a reassuring nature was noted in connection with this failure. When the roof fell the reinforced-concrete floor of the second story was called upon to sustain a severe impact, probably causing stresses of much greater intensity than it was designed to bear. The fact that only two comparatively small holes were punched in this floor and that the remainder apparently suffered no injury indicates that if corrosion of the reinforcing is occurring, it is progressing at a very slow rate.

Sewage Disposal Studies at Flint, Mich.

By J. R. Pollock
Sanitary Engineer, City Engineers' Department, Flint, Mich.

A RECENT study of the sewage disposal requirements of Flint, Mich., showed conditions typical of many other Middle West communities that have become intensely industrial in a short time. A year ago a study of the sewerage system and of the Flint River to find the proper form of disposal was undertaken by the writer.

During the last 20 years Flint increased in population from 13,103 to 91,599. Formerly a carriage factory



ROOF CONNECTIONS TO SANITARY SEWERS TRIPLE FLOW IN WEST SIDE INTERCEPTER

city, its chief industry now is the manufacture of automobiles, the output being 1,000 cars daily. As the demand for water from the Flint River as a water supply increases the volume to assist in carrying off wastes becomes less. The records for 1920 show a minimum dry-weather flow of 55 sec.-ft. and earlier records give a flood flow of 6,000 sec.-ft. The nuisance caused by the city's sewage at Flushing, a village of 1,000 located 10 miles below the city, is accentuated by a power dam in the village. It is no uncommon occurrance for an acre of floating sludge or scum to accumulate in front of the dam in 24 hours.

Studies of the effects of the sewage on the river for 36 miles below Flint since July, 1920, by sampling and observation trips at 8-day intervals, indicate that there is little oxygen in the river between Flint and Flushing, but five miles and farther below a high oxygen content was always obtained, due largely to algae.

One feature learned in the study of representative districts, but for which no practical remedy has been found, is that the roof connections to the sanitary sewers may more than triple the volume of flow to be provided for. The West Side intercepter drains 2,200 acres and has a tributary population of 35,000 people. What proportion of rain leaders are connected was not ascertained.

Experimental work on industrial wastes carried on for two months has indicated a way to treat the gas plant wastes. Oil from the various factories completely covers the river for days at a time. Its recovery is a logical procedure but what to do with the waste from one of the motor factories which imparts an orange color to the river for a mile downstream is a problem. The general plan is to demonstrate if possible to each industry some solution of its own waste problem.

Eventually the flow from 18 sanitary sewers discharging into the river will be collected by an intercepter and carried to a disposal plant which will probably be located four miles below the center of the city. In the program for intercepters and sewage-works recently submitted to E. C. Shoecraft, city engineer, it is proposed to install a sewage testing station in 1922, but it is not likely that sewage-works can be put into operation before 1925.

English Devices for Rail Renewals

LABOR SAVING appliances are being given much more attention than formerly by English railway engineers, owing to the increasing cost of labor, and two such appliances used in renewing rails on the London Northwestern Ry. have been described in the *Railway Gazette*, London, from which the following particulars are taken. Both of these devices were invented by men in the maintenance-of-way department.

Rail Distribution—For stringing rails along the roadbed, ready for removal, a pair of trolleys are used. Each

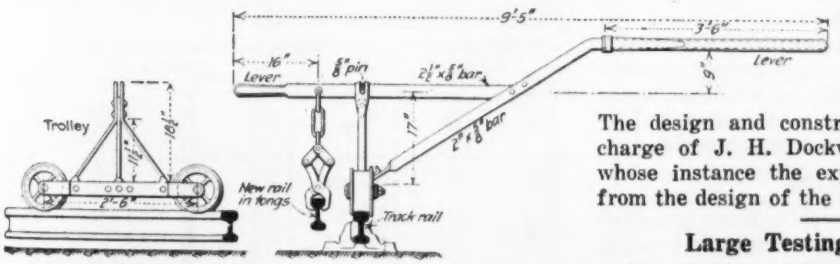


FIG. 1. TROLLEY FOR DISTRIBUTING RAILS

trolley has grooved wheels to ride on the track rail, a cross arm carrying rail tongs and a long lever on which one or two men bear to balance the weight of the rail in the tongs, as in Fig. 1. From four to eight men with the two trolleys can handle rails up to 60 ft. long. Each trolley complete weighs only about 115 lb. and its levers are easily disconnected. Two men with one trolley can shift heavy tools such as rail benders or jacks.

Rail Laying—For lifting out the old rail and placing the new one, there is the light portable gantry shown in Fig. 2. A timber beam 8 x 2½ in. is carried in A-frames or horses and has an iron strap on top with a ½-in. bar as the track for a trolley which carries a long lever set slightly diagonal to the track and beam. To the short end of the lever is attached a rail tong. When the splices are unbolted and the rail is free it is raised by two of the gantries, shifted outside the track and

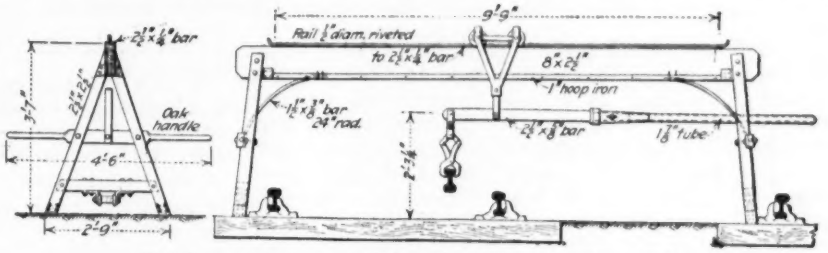


FIG. 2. GANTRY FOR REMOVING AND PLACING RAILS

lowered upon the roadbed. A new rail is then picked up by the pair of tongs, shifted into position and lowered upon the chairs or ties. The device complete weighs about 220 lb., so that it is easily placed on or removed from the track. Six or eight men with two gantries can handle heavy rails readily.

550-Ft. Concrete Warehouse Without Joints

A SEVEN-STORY concrete building, 550 ft. long and 100 ft. wide, has been completed in Los Angeles as the third unit in the Los Angeles Union Terminal. The other two buildings are of the same general plan and are 600 ft. in length. Differing from the other units in a few particulars, the recently completed structure has no expansion joints. This feature very considerably reduces the number of columns because where expansion joints were put in at 200-ft. intervals in the other structures twin columns were required, a set on each side of the joints on each floor. Observations will be made to see what difference there is in the action of the buildings with and without expansion joints. Graduated brass gages have been set at the top of the four corners of each building in prolongation of the side walls and these will be read with a transit from time to time to note any change in position. Measurement of the movement of adjoining sections at the expansion joints will also be made. The design and construction of the building was in charge of J. H. Dockweiller, consulting engineer, at whose instance the expansion joints were eliminated from the design of the new unit.

Large Testing Machine Calibrated

A comparison calibration of the 2,000,000-lb. chain testing machine of the Boston Navy Yard was carried out by the Bureau of Standards recently, using a 5¼-in. nickel steel calibration bar. The deformation of this bar was measured by a special extensometer in the large Emery machine at the bureau, measurements being made for 10,000-lb. increments of load. The bar and extensometer were then taken to the chain testing machine at Boston and six loadings to 1,000,000 lb. were made on a similar schedule. Comparison of the results showed that the chain testing machine was reading about 3.4 per cent higher than the large Emery machine.

Illinois Begins Traffic Endurance Test

Two-Mile Road With 63 Different Kinds of Pavement Will Be Tested to Destruction by Progressively Increasing Truck Loads

By Clifford Older
Chief Highway Engineer, Springfield, Ill.

In 1919 heavy truck traffic caused the partial destruction of a well-built concrete road in Cook County, Illinois. Inasmuch as at that time Illinois had arranged for funds approximating $100,000,000 for road construction, a contemplation of the expenditure of such a sum without knowing positively how to design a pavement to resist such traffic was disconcerting. An outline of the probable research work necessary to supply conclusive data on which a rational pavement design might be based was prepared. It immediately appeared probable that the complex problems involved would require much time for solution and in the meantime miles of pavements would be built in accordance with doubtful "rule-of-thumb" designs.

In order as quickly as possible to obtain more exact empirical data on which to base rural pavement designs, S. E. Bradt, state superintendent of highways, proposed that a test road be built in which should be included all commonly accepted types of pavement. It was proposed that the series of test sections for each type begin with a section obviously too thin and weak for heavy truck traffic and by progressive stages reach a section that in all probability would be strong enough to support without failure the heaviest trucks in common use, the road when completed to be subjected to truck traffic beginning with light loads and ending with loads about 50 per cent in excess of the limits provided by the Illinois statutes.

The plan was approved in 1920 by the state administration, funds provided and the co-operation of the U. S. Bureau of Public Roads secured. Construction was started in 1920, but owing to a late start, difficulties in securing materials and the painstaking care needed in the construction of each section, the road was not finished until the middle of June, 1921.

Tables I and II give an outline of the various sections as constructed. After much study the site selected was chosen because, throughout the length of the road, the soil, gradient, alignment and drainage conditions were as nearly uniform and representative of average Illinois conditions as possible. It being a relocation, public traffic will be prohibited until the test is completed.

Pavement Designs

The series of test sections of each type are expected to cover all reasonable variations in strength that might be required for roads carrying light, heavy or intermediate truck traffic. Each series begins with a section roughly estimated to be equivalent in strength to 4 in. of concrete and increases to the approximate equivalent of 9 in. of concrete. In comparing the strength of concrete pavements with other types, the following assumptions were made:

1. That the strength of a brick pavement constructed monolithic or semi-monolithic with concrete base is equal to that of a concrete pavement of the same thickness and of the same quality of concrete as that used in the base.

2. That the strength of a pavement consisting of bituminous-filled brick on a concrete base is equal to that of concrete slab of the same mix and having a thickness equal to that of the base plus one-half of the thickness of the brick surface.

3. That the strength of a pavement consisting of a bituminous wearing surface, either 2 or 3 in. thick, on a concrete base is equal to that of a concrete slab having the same mix but 1 in. thicker than the base.

TABLE I. BATES ROAD TEST SECTIONS OF BRICK AND ASPHALT ROADS

Lug and Lugless Brick with Bituminous Filler—Macadam Base

No. of Section	Length, Ft.	Thickness of Brick, In.	Cushion, In.	Base* Thickness In.	Total Thickness, In
1-A	100	3 lug	2 sand	4	9
1-B	100	3 lugless	2 sand	4	9
2	100	4 lug	2 sand	4	10
3	100	4 lugless	2 sand	4	10
4	100	4 lug	1 mastic	8	13
5	100	3 lugless	2 mastic	8	13
Total.....	600				

* Crushed limestone.

Asphalt Wearing Course—Macadam or Novaculite Base

Number of Section	Length, Ft.	Wearing Course, In.	Base Course, In.	Total Thickness, In.
6	200	2 Topeka	10 macadam	12
7	200	2 Topeka	8 macadam	10
8	200	1½ Topeka 1½ Binder	5 macadam	8
9	200	2 Topeka	6 macadam	8
10	200	2 Topeka	4 Novaculite	6
11	200	2 Topeka	4 Macadam	6

The coarse aggregate for the macadam base is crushed limestone.

Asphalt Wearing Course—Concrete Base—6-in. Curbs

No. of Section	Length, Ft.	Wearing Course In.	— Base Course — Thickness, In.	Mix	Total Thickness, In.
12-A	200	2 Topeka	4	1:3:5	6
12-B	25	2 Topeka	5	1:3:5	7
13	200	1½ Topeka	4	1:3:5	7
14	200	2 Topeka	4	1:2:3½	6
15	200	1½ Topeka	4	1:2:3½	7
16	200	2 Topeka	5	1:3:5	7
17	200	2 Topeka	5	1:2:3½	7
18	200	1½ Topeka 1½ Bind.	5	1:2:3½	8
19	200	2 Topeka	6	1:3:5	8
20	200	2 Topeka	6	1:2:3½	8
21	200	2 Topeka	7	1:2:3½	9
22	200	1½ Bind. 1½ Topeka	8	1:2:3½	11
Total.....	2,225				

Crushed limestone aggregate in base course.

Lug and Lugless Brick—Bituminous Filler—Concrete Base (6-in. Curbs)

No. of Section	Length of Section, Ft.	Thickness of Brick, In.	Cushion, In.	—Base Course— Thickness, In.	Mix	Total Thickness In.
23-A	100	3 lug	1 sand	6½	1:2:3½	10½
23-B	100	3 lugless	1 sand	6½	1:2:3½	10½
24	100	3 lug	1 sand	5½	1:2:3½	9½
25	100	3 lugless	1 mastic	5½	1:2:3½	9½
26-A	100	4 lug	1 sand	4	1:2:3½	9
26-B	100	4 lugless	1 sand	4	1:2:3½	9
27	100	3 lug	1 sand	4½	1:2:3½	8½
28	100	3 lugless	1 sand	4½	1:2:3½	8½
29-A	100	3 lug	1 sand	4½	1:3:5	8½
29-B	75	3 lugless	1 sand	4½	1:3:5	8½
30	125	3 lug	1 sand	3½	1:2:3½	7½
31	100	3 lugless	1 sand	3½	1:2:3½	7½
32-A	100	3 lug	1 sand	3½	1:3:5	7½
32-B	100	3 lugless	1 sand	3½	1:3:5	7½
Total.....	1,400					

Crushed limestone aggregate in base course.

Lug Brick, Monolithic and Semi-Monolithic—Concrete Base

No. of Section	Length Section Ft.	Thick. of Brick, In.	Type	—Base Course— Thickness, In.	Mix	Total Thickness, In.
33	200	3	Monolithic	2	1:2:3½	5
34-A	200	3	Semi-monolithic	2	1:2:3½	5½*
34-B	50		P. C. C.	Standard design		6
35	200	4	Monolithic	2	1:2:3½	6
36	200	3	Monolithic	3	1:3:5	6
37	200	3	Monolithic	2	1:2:3½	6
38	200	4	Monolithic	3	1:2:3½	7
39	200	4	Monolithic	4	1:3:5	8

* ½-in. sand cement bed.

All pavement sections were built 18 ft. wide. The subgrade and pavement surface were crowned 2 in. so that the thickness of each section is uniform throughout. Earth shoulders 6 ft. wide are provided on each side. The bottom of side ditches are uniformly 30 in. below the crown of the road.

Subgrade Construction

The soil throughout is the typical Illinois corn belt "brown silt loam" which is a very uniform finely divided material. Great care was taken in preparing the subgrade under all sections so that it would have the same treatment throughout. To accomplish this end the entire subgrade was plowed to a depth of 8 in. and rerolled with a 10-ton roller a day in advance of placing the slab. The forms were then placed and the subgrade thoroughly soaked at the end of the day. In the morning the subgrade was trimmed by hand to the exact elevation required.

For the purpose of determining the uniformity of the subgrade under each of the 63 sections comprising the road, observations were made for moisture content and bearing power of soil under both static and impact loads at points 25 ft. apart along the center of the roadway. These observations were made immediately before pouring the concrete. In addition to the above, samples of the subgrade, secured from different points along the road, were sent to the U. S. Bureau of Public Roads for analysis and laboratory determination of bearing power.

A penetration machine devised by the Illinois Highway Department, and an impact machine devised by the Bureau of Public Roads, were used at each observation point. Further observations of the subgrade under the pavement slab are being made by means of the subgrade testing cylinders described in *Engineering News-Record*, June 30, 1921, p. 1116. Approximately 1,000 of these are in place in the pavement. The results of the observations made by means of these devices are thought to be of great value but are too extended to be given here.

TABLE II. BATES ROAD TEST SECTIONS OF CONCRETE

No. of Section	Length, Ft.	Thickness, in.	Mix	Special Features
40	200	9	1:2:3½	None
41	150	8	1:2:3½	Transverse joints every 25 ft. Longitudinal joints full length of section. (See footnote No. 1).
42	150	8	1:2:3½	None
43	150	7	1:2:3½	Transverse joints every 25 ft. Longtitudinal joints full length of section. (See footnote No. 1).
44	150	7	1:2:3½	None.
45	100	6	1:2:3½	Transverse joints every 25 ft. Longitudinal joints full length of section. (See footnote No. 1). Pavement reinforced with circumferential reinforcing in 25 x 9-ft. sections. (See footnote No. 2).
46	100	6	1:2:3½	Transverse joints every 25 ft. Longitudinal joints full length of section. (See footnote No. 1). Pavement reinforced with circumferential reinforcing in 25 x 16-ft. sections. Transverse rods passed through longitudinal joints. No longitudinal rods adjacent to longitudinal joints.
47	100	6	1:2:3½	Transverse joints every 25 ft. No longitudinal joints. (See footenote No. 1). Pavement reinforced with circumferential reinforcing in 25 x 16-ft. sections. (See footnote No. 2).
48	100	5	1:2:3½	Special features same as Section 45.
49	100	5	1:2:3½	Special features same as Sec. 46.
50	100	5	1:2:3½	Special features same as Sec. 47.
51	100	6	1:2:3½	Wire mesh reinforcing used. (See footnote No. 3).
52	200	6	1:2:3½	None.
53	100	5	1:2:3½	Wire mesh reinforcing used. (See footnote No. 3).
54	200	5	1:2:3½	None.
55	200	5	1:2:3½	None.
56	200	5	1:2:3½	4% calcium chloride incorporated in 125 ft. 2½% calcium chloride used in 75 ft.
57	200	5	1:2:3½	Cemite cement used.
58	200	4	1:2:3½	4-in. rolled stone base course.
59	200	4	1:2:3½	Cemite cement used.
60	200	4	1:2:3½	2½% calcium chloride incorporate).
61A	100	4	1:2:3½	Hydrated lime 7½%.
61B	100	4	1:2:3½	None.
62	200	4	1:2:3½	Longitudinal joint full length of section; ¾-in. deformed bars 5 ft. long and 10 ft. centers across longitudinal joint; ¾-in. plain round painted bar 6-in. from each outside edge of slab. Longitudinal bar along edge continuous through sections 62 and 63.
63A	150	7	1:2:3½	Special features same as Section 62.
63B	50	7	1:2:3½	
Total..	3,800			

NOTE 1.—Transverse and longitudinal joints were formed by setting on edge strips of horizontally corrugated 16 gage galvanized iron 6 ft. long and 1 in. less in width than the thickness of the pavement. Width of corrugations 3 in.; depth 1 in.

NOTE 2.—All bar reinforcing, except in sections 62 and 63, consisted of ¾-in. round deformed bars placed 2 in. from the top of the slab and 6 in. in from the edges of the section with a 3-in. lap at intersections.

NOTE 3.—Weight of wire mesh approximately 45 lb. per 100 sq.ft. Total effective sectional area in square inches per foot parallel to center line and per foot of width was 0.087.

Construction Details

All work was handled by force account. All materials and construction details conformed strictly with the general specifications in use by the department. Rigid laboratory control of materials was had and detailed records kept. As the comparative strength of different pavement thickness is the chief object sought, uniformity in materials, proportioning and construction methods were insisted upon. The temperature of the air, mixing water, quantity of water, and all other items thought to have any bearing were recorded. No materials were dumped upon or transported over the finished subgrade.

Extreme care was used to construct each section to the thickness specified. Excepting where a sand or mastic cushion was specified a variation of ¼-in. is rare. Except as noted the average variation from the specified thickness is $\frac{1}{16}$-in.

Test Specimens

Nine 6 x 12-in. cylinders for compression tests and three 8 x 12 x 30-in. slabs for transverse breaking loads were made for each section involving the use of concrete. These specimens were cured in the same manner as the road. They will be broken in a calibrated testing machine to determine the strength characteristics of the concrete and the effect of age on the strength of the various sections at the time of truck loading.

Chief Problems to Be Solved

Although the truck loading of the Bates road is expected to afford empirical data of the greatest value, it has been considered essential that all possible efforts be made to solve the fundamental problems of pavement design. With this end in view an extensive series of investigations have been planned and nearly all of them are well under way.

Imposed loads.—(1) The magnitude of wheel loads which must be provided for. (This probably will always be limited by law.) (2) The impact factor as determined by the degree of smoothness obtainable under practical construction conditions and with various tire, spring and wheel designs. (3) The position of wheel loads to produce maximum stress. (4) The area of distribution of wheel loads with various kinds of tires.

Capacity to Transmit Loads to Subgrade.—(1) How to design and manufacture pavement slabs to resist most effectively compressive, shearing and bending stresses. (2) The determination of safe working stresses for the materials commonly used for pavement slabs. This item involves a determination of the effect of repeated loads.

Subgrade Support.—(1) The effect of the character of the soil. (2) The effect of the moisture content of the subgrade soil. (3) The control of the moisture content of the subgrade soil. (4) The effect of repeated loads on the subgrade. (5) Means for increasing the natural supporting capacity of subgrade soils.

Temperature Effects.—(1) Causing direct stresses. (2) Indirect, causing stresses by affecting the condition of subgrade support.

It is believed that truck load limitations, based solely upon the economics of truck transport, including pavement maintenance costs, may never be fully determined or at least fixed by considerations of ultimate economy. Load limits are likely always to be arbitrarily fixed regardless of economic limits, because of the existence of large investments in previously constructed roads, which the public is not willing to sacrifice. It would appear, therefore, that the best we can hope for at present is to direct load limit legislation in accordance with our best judgment, while over a long period of years data on ultimate highway transport economics may be accumulated.

It is believed that refinements of construction and maintenance methods which are now being tried will result in much smoother pavements and will greatly reduce the danger from impact. It is believed, however, that it is of great importance to find a means for readily determining the value of the impact factor for actual pavements of different degrees of smoothness.

The position of wheel loads to produce maximum stress presents no difficulties when the subgrade problem has been worked out. The area of distribution of wheel load is a function of tire design and easily determined.

Studies of Concrete

The design of concrete to produce reasonably definite abrasive, shear and compressive values is fairly well established. Professor Abrams of the Lewis Institute has undertaken the determination of the factors controlling the modulus of rupture of concrete and his bulletin may be expected shortly. It is believed that this is a matter of the utmost importance. An extended series of tests to determine the effect of repeated bending loads on plain concrete slabs is now under way in the laboratory of the Illinois Highway Department. Ultimately these factors must be determined for other types of rigid pavement slabs.

As to subgrade support, intensive research work has been under way in Illinois since October, 1920. Some 1,200 stations under pavement slabs are under observation. This investigation includes the effect of soil character, moisture content and repetition of loads, on the supporting capacity of the subgrade and means for controlling the moisture content. A repeated load subgrade bearing power determinator has recently been perfected and is now in use. Tentative conclusions are being checked by strain gage and deflection readings on actual pavement slabs subjected to both static and repeated loads.

The effect of temperature changes, as an indirect cause of stresses in a slab under load, has recently been found to be of surprising importance and is now under investigation.

It is planned to load the Bates road in the fall of 1921 if the test specimens show that the effect of the difference in age of the various sections is not great enough to lead to erroneous conclusions. The loading will be effected by passing trucks operated by trained drivers over the road. It is expected that batteries of at least ten trucks will be used for this purpose. A total of at least one thousand trips is to be made for each increment of load. It is expected that before the loading is started sufficient information will be at hand to make a reasonable prediction of the loads which will cause the first signs of failure of most of the sections.

The construction work was carried out by E. M. Fleming and R. R. Benedict, under the direction of B. H. Piepmeier, engineer of construction. The research work is under the immediate direction of H. F. Clemmer, engineer of tests, with C. A. Hogentogler, highway engineer, of the U. S. Bureau of Public Roads, co-operating.

MAIN FEATURES OF CONCRETE ROAD TEST SECTIONS

Section	Thick., In.	Width, Ft.	Reinforcement: Longitudinal	Reinforcement: Transverse	Tons per Mi.	Subgrade	Remarks
A	5	18	½-in. bar at center and each edge. . .	½-in. bars, 18 in. c. to c. . .	15	Crushed rock, 1 ft. at center, 4 in. at sides	
B	5	18	½-in. bar at center and each edge. . .	½-in. bars, 18 in. c. to c. . .	15	Adobe	
C	6	18	None	None	None	Adobe	Arizona type-section thickened to 9 in. at edges.
D	8	20	None	None	None	Adobe	Thickened to 1 ft., 8 in., at edge (inverted curb).
E	6	18	Two ½-in. bars at each edge	½-in. bars, 7½ in. c. to c.	69	Adobe	Reinforcement at both top and bottom of slab.
F	8	18	None	None	None	Adobe	
G	5	18	Two ½-in. bars at each edge	½-in. bars, 7½ in. c. to c.	69	Adobe	Reinforcement at both top and bottom of slab (like section E).
H	6	20	Two ½-in. bars at each edge	½-in. bars, 7½ in. c. to c.	69	Adobe	Reinf. top and bottom. Slab thickened to 1 ft. 6 in. at shoulders (inverted curb).

Build Concrete Pavement for Test To Destruction

Slabs of Various Designs Included—Special Reinforcing Steel Developed—Trucks To Wear Out Pavement

A "RACE TRACK" or elliptically shaped roadway of plain and reinforced concrete is being constructed near Pittsburg, Cal., which is to be tested to destruction by operating over it motor trucks of various sizes and weights. The purpose is to determine by observation under the same conditions of wear and on the same subgrade, the relative merits of different materials and cross-section design and at the same time to develop, if possible, an improved type of plain and reinforced concrete pavement. In line with this latter purpose, two of the eight or more sections that will be laid will be reinforced with a special steel of very high tensile strength which is expected to strengthen the slab more than would be feasible even with an excessive amount of commercial grade steel.

The steel of high tensile strength was developed ex-

pressly for roadbuilding purposes by the Columbia Steel Co., of Pittsburg, Cal., which has undertaken the construction of the test pavement. In addition to the two sections in which the special steel will be used, as many other designs as possible have been sought from the state highway commission, county highway commissions, and individuals.

The appeal to popular interest has attracted much attention. Cement, sand and gravel are being contributed by interested firms, equipment for the construction has been loaned by manufacturers, a contractor has undertaken the work for the bare total of force account and expenses, all testing work is being done gratis by a local firm of testing engineers, and trucks for the test of the pavement will be operated by the Motor Car Dealers Association at their own expense.

The test is planned to develop data on the most satisfactory design of concrete pavement. The best methods of preparing and draining the subgrade were held to be matters so largely dependent on local conditions that each highway engineer will always have to solve these problems for each particular case and the proper treatment for the various soils, it was felt, should be left to the Bureau of Public Roads which is now conducting research along this line in California. The test road is being constructed on black adobe and provision is being made alternately to flood and dry out each section of the subgrade.

The test road will be 18 ft. wide on tangents and 20 ft. wide on curves, 1,370 ft. long on the center line and will comprise sections of pavement differing in design as well as in the quality and location of reinforcing. In accordance with other endeavors to secure the best concrete, the pavement is to be kept under water fourteen days and traffic will not be allowed on it for a total of forty-four days after pouring. In addition to surface inspection and tests, the flexure of the concrete slab and the tensile stress in the steel will be studied by means of instruments in four transverse tunnels built beneath the subgrade before paving was started.

At the outset of the traffic run, nothing heavier than 3½-ton trucks will be permitted. Later heavier trucks will be used and as sections of the pavement are destroyed temporary repairs will be made so the remaining sections can also be tested to destruction. It was expected that the pavement would be completed and ready for traffic tests by the end of July.

The research work is under the direction of Lloyd Aldrich, consulting highway engineer and J. B. Leonard, consulting structural engineer.

Water-Works Publicity at Terre Haute

One of the advertisements run by the Terre Haute Water-Works Co. in the newspapers of Terre Haute on the occasion of the recent visit of the Knights of Columbus to that city was a quarter-page cut showing two curves. The first curve was of the constantly reduced typhoid fever death rate from 60 per 100,000 in 1909 to 4 in 1920. The number of consumers is shown below rising from 5,200 in 1910 to 8,200 in 1920. A note reinforcing the pictorial thought states: "As the number of city water consumers increases the typhoid death rate decreases." Another clipping from Terre Haute shows the picture of Dow R. Gwinn, president of the water company, as the eighth in a series of citizens "who are doing their part for the business progress of the city."

Recent Developments at the University of Cincinnati

Courses in Commercial Engineering, a Hobby Hour and the Hanging of Fine Paintings Among Innovations

AMONG engineers, as well as among educators, the University of Cincinnati is known as the home of the most important recent development in American engineering education. The co-operative system was inaugurated there by Dean Schneider fifteen years ago. The methods have been evolving year by year, and always in this period of development fresh inspiration was drawn from every visit to the university. Nor is there any change now, even though the organization and methods have been brought to a high degree of perfection. There is still the freshness of attack shown by the early experiments. What is more, the fifteen years of experience have brought a greater vision of the possibilities of the co-operative system.

The freshness of attack, the willingness to try promising proposals, is displayed in two innovations—one of a year's, and the other of two years' standing, the first being the introduction of a "Hobby Hour," and the second, the hanging in the corridors of fine examples of contemporary painting.

The broader vision is displayed by the application, beginning last September, of the co-operative method to a course in commercial engineering, and by the studies under way of proposed co-operative courses in architecture, in economic geology and in industrial management.

The Hobby Hour

The hobby hour is by far the more unusual and original of the two recent innovations. It grew out of Dean Schneider's constant effort to bring out the personalities of his students and to develop them into many-sided men. For fifteen years there has been close study of the aptitudes of the students and an effort to place them at work that would afford the proper stimuli for their development. Shifting of students from one type of work to an opposite type or from one course to another has been a frequent means of orienting misplaced individuals. It was therefore argued that if the students' interest could further be aroused by elevating their private hobbies to a new dignity, backward men would be brought out, individualities and personalities developed, and a valuable ally found in the effort to develop the students.

It was laid down as the basic principle that there should be leadership and assistance in the hobby, so that its value might be as great as possible. Whatever was to be done was to be well done. Every hobby was to be looked on not as a superficial activity—a means of wasting time—but as one warranting the students' best energies. In all cases, the college was to engage the instructors.

After full consideration, the idea was laid before the student body and enthusiastically adopted. It has been operative since November of last year. All activities are under the management of the Student Tribunal, which is the controlling body in the student government—a feature of many years' standing in the college.

The period from 1 to 2 is set aside every day as the Hobby Hour. The luncheon period is from 12:30 to 1, so that the noon intermission is 1½ hours.

Aside from those of an athletic character, there are, thus far, nine major Hobby-Hour groups: the Orchestra, the Glee Club, the Band, the Sketching, Camera, Literary, Wireless, Psychology, and Pekin clubs—the last a group for the study of Chinese customs and language. A group of good size is studying stenography, while among the lesser groups are the Psychology of Color, Advertising, Science of Government, and Chess clubs. Groups of two and three students are pursuing still other lines. The athletic clubs are numerous and strong, embracing football, baseball, basket ball, tennis, boxing, wrestling and swimming. Already there are plans for a Russian and an Arts and Crafts club next year. Each club meets two or three times a week so that a student can belong to more than one club. Some students were found to be without hobbies, and had to find them, in some cases shifting from club to club until they were satisfied.

Each group elects its own president and secretary. The university has engaged the leaders or instructors, sometimes from the faculty; sometimes from the town. The sketching instructor, for example, is a member of the art faculty of the university; the leader of the Pekin Club is a post-graduate Chinese; the instructor of the orchestra comes from the town.

The results have fully borne out the expectations. Backward men have been shown in a new light. Their keen interest in their hobbies has discovered their latent abilities to the faculty. Personalities have been emphasized and confidence developed. Moreover, as a result of the diversion, the students are found to be as fresh in the afternoon as in the morning.

An indication of the enthusiasm of the student body for the idea is afforded by the decision to establish next year a quarterly student magazine to be called the *Co-operative Engineer*, and to be published by the Literary, Sketch, Camera and Advertising clubs. It will be broadly representative of the college's activities and will not be a technical journal, differing in that respect from the magazine activities of most engineering colleges. It is being planned with very high standards, and the manuscripts and advertising copy already in hand give promise of a distinctive publication.

Advertising as a University Problem

The proposed method of handling the advertising is especially worthy of mention. It was desired to get away from the charity appeal so common in soliciting advertising for college papers, and also to secure a rate that would fully support the magazine. It was decided, therefore, to attempt to give the advertiser something that he could use in his advertising in other mediums than the *Co-operative Engineer*. The "copy" will be based upon research along historical and scientific lines, done chiefly by the commercial engineering students as university problems.

As may be expected, doubt was expressed, when the Hobby-Hour idea was first proposed, as to the advisability of its adoption. As a result, however, of over seven months of operation the educational benefits have been found more than to justify the time expended. It is no longer looked upon as an experiment, but as a permanent part of the work of the college.

The second of the innovations is the establishment of the practice of hanging oil paintings of a high degree of excellence in the corridors of the college. This plan is also in pursuance of Dean Schneider's efforts to develop his students broadly. The hanging was begun about three years ago, and now there are some thirty paintings in the corridors of the college. So well have the selections been made that some of the paintings have already appreciated greatly in value.

No rule is laid down as to the subjects of the paintings. They run the whole gamut of artistic inspiration—landscapes and sea views, street scenes, character studies, and occasionally a treatment of an engineering subject. No effort is made to use them for instructional purposes, but their influence is apparent from the care with which the paintings are studied by the students. Whenever a new painting is hung it is the center of interest for months. Little groups discuss its technique, its general effect, and its shortcomings. The interest in art that has been stimulated is shown by the constant demand for the visitors' tickets sent to the college regularly by the Cincinnati Art Museum. Possibly a still better indication of the students' interest is the fact that all of the paintings, with a couple of excepions, have been presented to the college by the students themselves, through their clubs and class organizations. Only the purchase of the first few pictures was stimulated by Dean Schneider.

Commercial Engineering

In the development of the co-operative system the most important recent step has been the introduction of a co-operative course in commercial engineering, which dates from last September, though some work had been done in this direction in the year that preceded. The new course was introduced in response to a clearly expressed demand. It was found that many of the graduates of the regular engineering co-operative courses were being drawn into executive work. Upon examining the work of these graduates and studying, broadly, the type of training that would best fit men for executive places in industries having an engineering basis, it was decided to develop a three-year commercial course resting on a foundation consisting of the standard first two years of the co-operative course. In other words, the commercial engineering students take the same work in their first two years as do the students in the usual engineering courses.

The specific purpose of the last three years is to turn out men who are prepared to aid in developing the marketing side of industry. That being the case, no courses are given in retail selling. The work is specialized in the direction of factory marketing.

The courses are built upon a study of world resources. Courses in geography, dealing with climatic and topographical conditions, minerals, and agricultural products, lead up to a study of the psychology and history of nations. Strong emphasis is laid upon the social and economic development of England and the British Empire, to a careful survey of the leading European nations since the Congress of Vienna, and of the economic and social development of the American nation. Such things as the rise and spread of democracy, the industrial revolution, the rise and spread of trade unionism, the balance of power, etc., are pursued as a necessary part of the equipment of an executive who is looking to the best possible marketing of his product, and at the same time to secure greater stability through diversification of outlet.

As part of the foundation, also, are special courses in

mathematics, including calculus and the theory of variations, terminating in a course in statistics. Preliminary to the latter, special attention is given to the interpretation of formulas and the making of slide rules.

Following these, geographical, historical, and statistical studies are the courses in accounting, economics and finance customary in collegiate business courses.

As in the regular engineering courses, the co-operative system is applied throughout the course. During the first two years the student spends half of his time in shops. Here the future commercial engineer gets a familiarity with production methods. He learns how the products he must sell are made. Then, when the regular engineering students are being graduated from the shop into the planning, design, and research departments, the commercial engineering students go into the accounting, the stock, the buying, the cost, the promotion, and the sales departments. In the first two years the alternations are by two weeks' periods. In the last three years, by monthly periods—which, by the way, is now standard also for the final three years of the regular engineering course. (Until recent years the alternation for the entire course was in bi-weekly periods).

The industries in which the co-operative commercial students work are quite as varied as those in which the regular engineering students are employed, and include packing, publishing, advertising, banking, and the manufacturing of many products, from paper cartons and soap to machine tools. The course has met with quite as hearty response from the industries of Cincinnati as has the regular engineering course. One of the most gratifying experiences has been that the banks took the initiative in asking that co-operative students be placed with them. During the discussion as to the type of training needed for banking work, the bankers insisted that no change be made in the course, for, they contended, the banker needed to know quite as much about production and marketing as he did about the intricacies of finance.

As with the other co-operative engineering students, the commercial engineers must throughout their course submit bi-weekly reports on their field work together with complete semestral summaries. Each man is given from twenty minutes to half an hour to present the semestral report, after which it is fully discussed by himself and by his fellow students. Reports examined at the university last month indicated a remarkable grasp of the industries in which the students are working.

Other Developments

Last year 900 co-operative students were enrolled in the Engineering College of the university, and the number expected next year is 1,100. As in all previous years, applications for admission are in excess of the number that can be accommodated.

Year by year the area covered by the co-operating industries has increased. During the last year co-operative students were located in industries in Pittsburgh, while next year there will be co-operating industries in Chicago and Milwaukee as well. In general, the co-operating zone is considered to be any point that is within an overnight ride from Cincinnati, embracing, in general, Pittsburgh on the east, Chicago on the west, Cleveland on the north, and Chattanooga on the south. The students in factories at the greater distances are those in the third, fourth, and fifth years, when the alternation is in monthly periods.

The college now has under consideration the introduction of co-operative courses in architecture, economic geology, and in industrial management. The expected introduction of these courses is due to the policy of the university of regarding itself as a service department of the city. It proposes, as far as its resources allow and the demands are clear, to meet the needs of the industries which make up the life not only of the city but of the territory tributary thereto. It is this point of view that promises continued broadening of the work of the college and of the application of the co-operative idea.

Conclusion

It was stated in the first paragraph, there is still the same inspiration to be derived from a visit to the University of Cincinnati as there was in the days when the co-operative scheme was in its infancy. The innovations and developments here set forth should indicate to the reader that this statement was fully justified.

E. J. M.

When Water-Works Conduits Ran Wine

IN THESE dry days a tale of water-works conduits that "ran with Claret Wine" seems like a fairy tale; but it is merely a true "tale of the olden time." It was on Jan. 1, 1684, in the old city of Lincoln, England. The days of Cromwell and the Puritan Commonwealth were fading from memory. Charles II had granted the city of Lincoln a new charter under which, according to a paper by Charles Horobin, water-works engineer of Lincoln, read before the Institution of Water Engineers, the city was granted the right "to hold a fair for horses and all manner of things [note the omnibus clause] in April of each year." The charter having been brought to the city by Sir Thomas Huffey, accompanied by several "Deputy Lieutenants and other Gentlemen of Quality," the royal document and the party bearing it were met, according to the London *Gazette* of 1684,

> . . . without the City gate, by the Mayor, Aldermen and Common Council-men in their formalities, and by about 3,000 of the inhabitants of this City and liberties thereof; and from thence proceeded to the Town Hall, and trained Bands being in arms and drawn up on both sides of the streets through which they passed, the bells ringing, music playing and the people expressing their satisfaction with repeated acclamations. Being come to the Hall the Charter was read by the Town Clerk, and the Mayor, Aldermen and Sheriffs were sworn, which being done, the whole company went and drank the King's Health at the first Conduit *which ran with Claret Wine from one o'clock to six at night*, and the Gentlemen were entertained by the Mayor at a very Noble Dinner; after which they all drank the Duke's Health at *the other conduit, which likewise ran with Claret Wine during the said period;* the whole concluding with Bonfires and ringing of Bells. [Italics ours.—Editor.]

Nothing just like this has ever been recorded in American water-works history, so far as known records show, but tradition has it, and it is thought that there are those living who can attest it as a fact, that years ago, at one of the annual conventions of the American Water Works Association, there was a fountain from which there flowed, except water, every kind of drink that any reasonable man could wish.

Practical Hints on Erection, Operation and Maintenance

Concrete Chuting Plants

THERE are two types of concrete chuting outfits in use, (1) boom plants under which may be classified unit plants and (2) continuous line plants. The continuous line plant has cable-supported chutes. It is the original form, but has been perfected by including improvements developed in the boom plant.

The boom plant is used almost entirely for building work, and, it is worth noting, is probably the largest machine built commercially for handling concrete. Fig. 1 shows the various parts and the diagram, Fig. 2, indicates the variety of chute ranges. The great range—the chief advantage of the chute system—is apparent from the drawing. The unit plant differs from the boom plant in that it has no separate boom. The first section of the chute is trussed and a head line as shown by Fig. 3, is used. This type of plant is of a simpler design and as a general rule is less expensive than the boom plant, although it requires about 10 ft. more head room to maintain the proper angle for the head line.

For continuous line plants, which are best suited to bridge and dam construction and other types of extensive operations, the arrangements are more varied. The diagram, Fig. 4, is a simple example. Here counterweight chutes, developed primarily for boom plants, are added to give the chutes range beyond the line of the supporting cable.

THERE are brought together in this article hints as to the best methods of erecting, operating and maintaining concrete chuting plants. These are the crystallization of the best experience of users and manufacturers. Information of this kind is particularly valuable now because chuting plants are no longer mere collections of odd units, but are well thought out machines, in which every part has been carefully designed for its special work. With such highly developed plants, the greatest economy can be secured only by skill and care in erection, operation and maintenance. It is with the idea of telling what has proved to be the best practice that this article has been prepared.—EDITOR.

PLANT CONSTRUCTION

Both steel and wood towers are used for chute plants. Although sectional steel towers are the most economical in the long run, there are still more wood towers used than steel. The life of a wood tower is limited to two or three jobs; the steel tower, with ordinary care, should be good for an indefinite number of jobs. The first cost of a steel tower is greater than that of the wood, but the steel tower effects a saving in erection and dismantling cost which pays for it on three or four jobs. Wood towers may be bolted or spiked; the salvage is greater with the bolted. A good average figure for replacement on a wood tower is 35 per cent for erection. Steel towers are built in sections of 15 or 20 ft. Each tower has a standard bottom section which contains the tilting chute and swivel sheave and a top section which contains the necessary top sheaves. It may be increased or decreased in size by adding or subtracting standard intermediate sections. All steel towers are fabricated to template so that the various parts are interchangeable.

Whether using wood or steel towers, the rule for determining the maximum height of the tower required is as follows: "Take the maximum height at which concrete is to be poured above the tower base and add to this one-third of the distance through which the concrete is to be chuted, which takes care of the necessary fall in the chute line. To this sum add 20 to 30 ft. for necessary tower head room."

There are two general types of chute sections, the half-round and the egg-shaped. Each has its particular advantages and each fills all general specifications. Any chute 12 in. or 14 in. wide and at least 8 in. deep will handle all the concrete that it is practicable to hoist into it, *under average conditions*, if placed on a slope of one vertical to three horizontal, the recommended slope for chutes.

Chutes are now used in the construction of dams and other massive structures where plum stones were formerly used, it having been found that a 1:3:6:3 mix can be thus employed and handled at a considerable saving in cement. By this mix is meant one part of cement, three parts of sand and six parts of stone passing through a 2-in. screen and three parts of stone passing through a 4-in. screen.

The standard chute made by various manufacturers in this country is, at the present time, 12 or 14 gage metal. The heavier chute means longer life and the length of life of a chute depends entirely upon the type of aggregate used in the concrete. Gravel is comparatively easy on chutes but trap rock or very sharp, hard sand shortens the life of the chute considerably. The method used for prolonging the life of a chute is relining. These reliners can be placed in the chute at the factory or later on at the job. They consist of a sheet of metal shaped to conform with the chute and of the same thickness as the chute. This reliner covers that part of the chute which comes in contact with the concrete.

It is very hard to state definitely the length of life of a chute in cubic yards of concrete as it depends upon so many different factors. As a general average, the 14-gage chute has a carrying capacity of between 8,000 and 10,000 cu.yd.

Chute connections are a very important feature of chuting equipment. They are of two kinds: one for continuous line chute where no change in direction is required nor swiveling action necessary, and one for boom, unit and continuous line plants where swiveling is a necessary requirement. The purpose of the first type of connection is to provide flexibility in the chute line. It should be easy of attachment and not change or interrupt the flow of concrete. The purpose of the second type is to provide means for swiveling so that the concrete can be poured over a considerable area from the end of the chute. This chute connection should be designed to reduce splashing to a minimum, provide a stable support to prevent the chute from tipping, and to give, as near as possible, no interference to the flow of concrete. In selecting any chute section it is advis-

able to see that the chute is so designed that either type of connection can be removed or attached at will, as the chute on one job may require a continuous line joint, and on another job, the other type.

There are certain relations between the size of mixer, size of elevator bucket, and size of tower hopper which should govern the selection of a plant. The table below gives a suggestion as to this relationship.

Size of mixer	14-S	21-S	28-S
Size of bucket	14 cu.ft.	22 cu.ft.	28 cu.ft.
Size of hopper	20 cu.ft.	30 cu.ft.	40 cu.ft.

In general, the rule may be stated in this fashion. "The working capacity of the elevator bucket should correspond with the wet batch capacity of the mixer. The tower hopper should be at least 50 per cent greater in working capacity than the elevator bucket to allow for unforeseen holdups in pouring, and additional storage capacity."

Plant Location

While the conditions are so divergent that it is impossible to lay down specific rules on plant installation, there are certain general rules which should be followed in so far as possible:

1. Since the cost of handling materials behind the mixer is of equal importance to the cost of handling the mixed concrete, the receiving and handling of cement

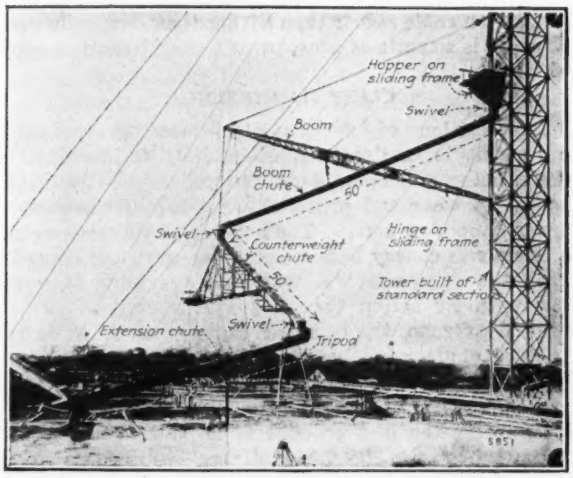


FIG. 1. A TYPICAL BOOM CHUTING PLANT SHOWING METHOD OF EXTENDING RANGE

and aggregates should be convenient to the mixing and hoisting plant.

2. It is desirable to locate the hoist tower in a central position so that the semi-circular radius of action of the boom can be utilized to full advantage.

3. The maximum efficiency of operation of boom plant equipment is confined to placing concrete within 130 to 160 ft. of the tower base. Where the reach is in excess of this distance, study is required to determine whether it would be more advantageous to chute the concrete into floor hoppers located at central points and within 130 ft. from the base of the tower and to handle it from these hoppers to the far portions of the work in buggies, or to attempt to cover the far portions of the work directly from chutes, using the more or less troublesome floor supports that would be required.

4. To warrant the installation of a steel-tower, quick-shift, counter-shift, counterweight-chute plant, the work should contain at least 4,000, or better 5,000 cu.yd. of concrete.

5. Where a building is so large that it is not possible to cover the entire work from one tower, the yardage of concrete will determine whether a two-tower plant should be installed or whether a one-tower plant should be used and buggies be employed as an auxiliary means of distribution.

6. The height of work does not offer serious difficulty as steel towers are now being constructed to heights

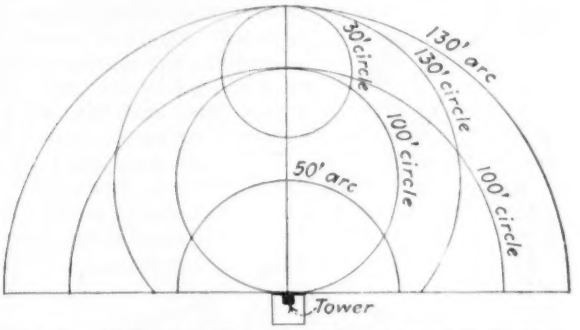


FIG. 2. DIAGRAM SHOWING VARIETY OF RANGES OF A BOOM PLANT

as great as 240 or 280 ft., this height covering the exceptional job. The ordinary building can be covered by a tower 200 ft. or less in height.

There are, of course, occasional construction operations involving the placing of large yardages of concrete which cannot be covered by general rules. In such cases it is wisdom to call into consultation experts who have had a wide experience in the handling of special work.

Plant Erection

Towers, whether of wood or steel, should be guyed at 40-ft. intervals, these guys to run off to suitable anchorages at a slope of not less than 45 deg. with the vertical. Turnbuckles, with shackles, should be inserted at both the tower and anchorage ends of the guy lines; the turnbuckles make it possible to take up slack in the guys for the purpose of plumbing the tower and the shackles make it easy to "slip" a guy line either for the purpose of allowing a boom to swing, or for clearing some obstruction.

A crew of seven men and a foreman should erect 80 ft. of tower per day and set the guys. The dismantling of the equipment can be accomplished in approximately one-half the time required for erection.

It is always advisable to have the hoisting engine on the job before the erection of the tower is commenced so that it will not be necessary to lift the tower parts by hand. First the bottom frame of the tower is set in place and the four lower corner posts are bolted into position and held together by the required struts and diagonals. All that is necessary for handling subsequent members, as the work gets away from the ground, is a light wooden gin pole about 16 ft. long, having a heavy spike in its lower end. The spike fitting in between tower members, will provide a good swiveling support for the pole, which is set within the tower and leaned over so that the upper end is outside and in a suitable position for hoisting the tower members.

All bolting of gussets and small members should be

done on the ground so that mid-air work may be held down. Experienced iron workers will have no trouble in getting the various parts together since similar parts are interchangeable. The heaviest members are the corner posts which are 20 ft. long.

The one caution in connection with the erection of a steel tower refers to the tightening of the bolts. While all bolts should be put in place as the tower progresses in height they should not be tightened, this tightening should be postponed until the tower has been carried to its full height and plumbed, after which the erectors will go over it making sure that all bolts are properly tightened. After the tower is in place the sliding frame fixtures are put on the tower at ground level and the tower hopper is bolted into place at a convenient elevation. The boom is then erected on the ground and the sliding frame is raised sufficiently to allow the boom hinge connection to be put in at ground level. The boom is then rigged at the proper inclination and the entire plant lifted to an elevation convenient for attaching the counterweight chute, this counterweight section likewise having been completely assembled on the ground. By this method there is practically no mid-air work after the tower has been erected.

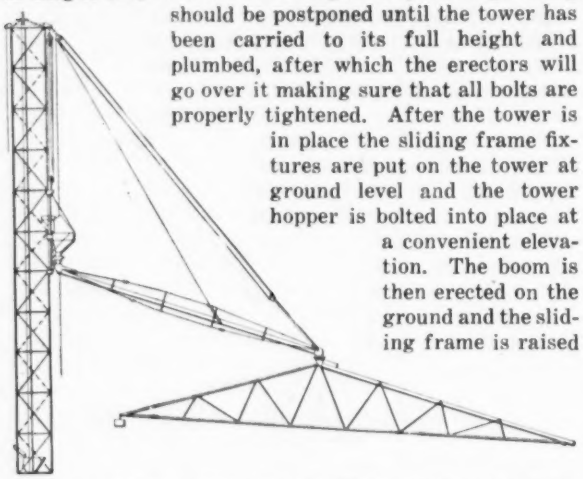


FIG. 3. TYPICAL UNIT PLANT WITH TRUSSED CHUTE REPLACING BOOM

In building a wood tower, carefully constructed templates should be made exactly in accordance with the tower drawings. These templates should contain the exact location of all bolt holes. If possible each timber should be marked with a number. In other words, the corner posts should all bear one number, the cross braces another, sway braces another, and so on. By so numbering, the workmen who are erecting the tower can signal for a certain piece of timber and be assured that when it is sent up it is the proper piece. One of the most important things in erecting a wood tower is the guying, and at the time of starting to erect the tower, the first thing that should be done is to locate the guy anchors or deadman in order that there may be no excuse for continuing the building of the tower without guys because no anchorages have been provided. When the tower has reached the height of between 35 and 40 ft. the first set of guys should be attached. If the contractor plans to use his wood tower on two or three jobs it should be of bolted construction.

Continuous line chutes are made in lengths of 10, 20 and 30 ft. A continuous line chute connection should be placed at least every 30 ft. in the line, and the chute line should be supported by manila rope from the main cable at least every 30 ft. and preferably every 20 ft. The overhead cable should be of plowsteel. The supporting ropes should be ¾-in. manila. A double 6-in. wood block and a 6-in. single wood block should be used with the manila rope for supporting the chutes. The chutes are equipped with hangers for attaching the supporting ropes.

The sketches in Fig. 5 show two methods for connecting the manila ropes to the overhead cable. The overhead cable may be firmly lashed to the top of the hoist tower at the point where it crosses the tower and the back kick of the line can be taken care of independently, or the overhead cable can be run on a set of rollers over the top of the tower into a dead man. Both methods are used in actual practice and both methods are satisfactory. The sag in the supporting cable should be from 8 to 12 per cent. The approved method of placing long lines of cable-suspended chutes, is first to put up the chute suspension cable and then to put the chutes in place at ground level, one by one, pulling the entire line up toward the tower as the line of chutes is lengthened. Standard trolleys which ride on the suspension cable can be obtained for this purpose. These trolleys are held in their proper position on the cables by a spacing line. Running the chutes up on the suspension cable rather than lifting them vertically into place, as is sometimes done, saves a considerable amount of labor.

Plant Maintenance

Depreciation of modern steel-tower gravity-plant equipment is confined almost entirely to the chutes, there being otherwise only the rollers on the hoist bucket to wear and practically nothing on the tower, tower hopper or boom. The amount of concrete which a chute will convey before becoming worn out depends upon the aggregate. A trap-rock aggregate is more severe in its action than a gravel aggregate. As a general average, the carrying capacity of an ordinary 14-gage chute runs between 8,000 and 10,000 cu.yd. Where it is known that a given set of chutes will have to handle more than this amount of concrete on one installation, the best practice is to have interliners of like weight put in the chutes at the time of their manufacture. These liners extend up on the sides of the chutes only as far as the concrete normally piles in transit.

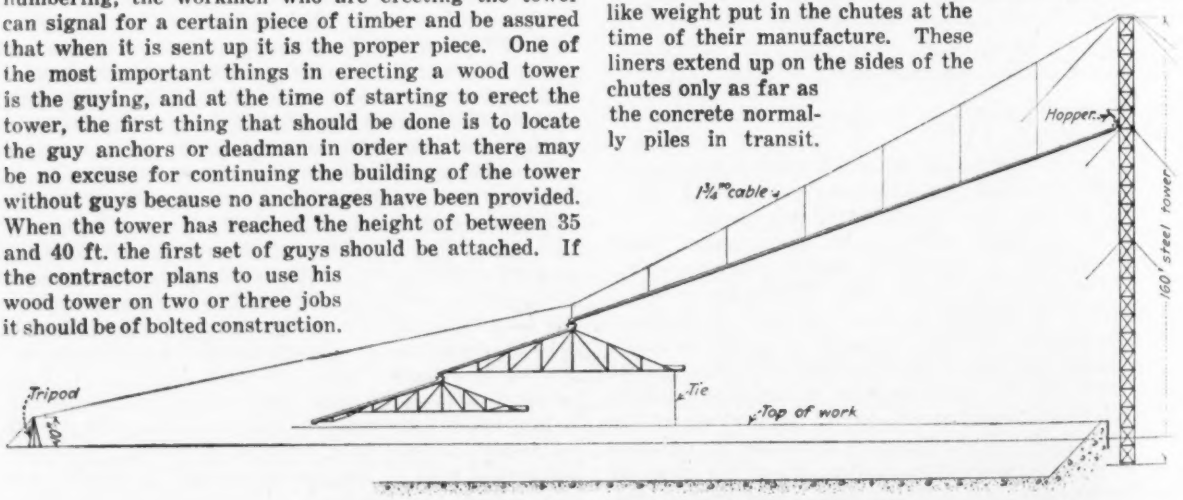


FIG. 4. ELEVATION OF A TYPICAL CONTINUOUS LINE PLANT

At a time when the original unlined chute would be worn out only the liner plates on the lined chutes will have become worn through. It is relatively simple and inexpensive to replace these plates, thus making the chute sections practically as good as new.

To hold down the depreciation of chutes, they should be handled with reasonable care so they are not dented (a high spot in a chute very soon results in a hole) and

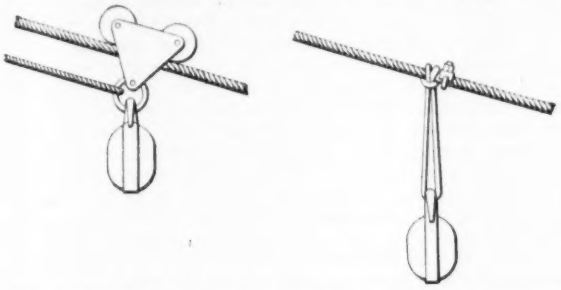


FIG. 5. HANGER CONNECTIONS TO SUSPENSION CABLE

they should be kept clean. The approved method of keeping the chute lines clean is either to run a water line to the tower hopper or to elevate water in the hoist bucket, and flush the chute line whenever operations are to cease for a period in excess of half an hour. The addition of liners of course makes the chutes stiffer and reduces the chances that they may become dented. Chutes, as they leave the manufacturer, are ordinarily painted on the outside and given a slush coat of heavy oil on the inside, it having been found disadvantageous to paint the inside because the paint, until worn off, seriously retards the flow of concrete. When equipment is to be laid up for the winter, good practice indicates that the painted parts be repainted if they have been weathered to any considerable extent, and that the inside of the chutes be covered with a slush coat of heavy oil.

Plant Costs

Cost varies with the character and extent of the equipment. The cost of a specific installation and of a representative operation are, therefore, as truly indicative as are general figures, which have to be qualified in many ways. Any cost figures it may be repeated are merely indicative. Absolute costs cannot be given. These warnings must be kept in mind in studying the examples cited.

The cost of a 160-ft., 1-cu.yd. batch steel tower determined on a building operation in New York City in July, 1920, was:

Steel tower		$2,325
Blocks and cable		325
Erection at $1.50 per ft.	240	
Dismantling at 50c. per ft.	80	
Depreciation 5 per cent on $2,650	133	
Trucking	50	
Total fixed chrges		$503
Total charges—1st job		$3,153

An estimate of the cost of a timber tower for the same operation is as follows:

Cable and blocks		$325
Lumber (50 bd. ft. per running ft. @ $80 per M)	640	
Framing at $1.50 per ft.	240	
Bolts and nails at $1.25 per ft.	200	
Tower before erection		$1,080
Tower erection: $1.50 per ft.	240	
Dismantling at $1	160	
Depreciation at 50 per cent of $1,405	703	
Trucking	50	
Fixed charges		$1,103
Total charges — 1st job		$2,558

As an example of operating costs the Gardner-Lucas Building, New York City, is selected. This building was constructed in 1920. It required about 8,000 cu.yd. of concrete and the organization was as follows:

1 foreman at $1 per hour, per day	$8.00
1 hoisting engineer at $1 per hour, per day	8.00
1 mixer engineer at $1 per hour, per day	8.00
1 laborer on sand at 60c. per hour, per day	4.80
1 laborer on gravel at 60c. per hour, per day	4.80
2 laborers on cement at 60c. per hour, per day	9.60
1 laborer on hopper at 60c. per hour, per day	4.80
1 mixer operator at 70c. per hour, per day	5.60
1 mixer helper at 60c. per hour, per day	4.80
2 laborers spreading, 60c. per hour, per day	9.60
2 chute handlers at 60c. per hour, per day	9.60
	$77.60

The average day's run was about 300 cu.yd., making the cost of mixing and placing about 25c. per cubic yard. The average mixing and placing cost for the entire job was 36c. per cubic yard.

A man with a buggy will average 12½ cu.yd. per hour, or 20 cu.yd. an eight-hour day. It would require fifteen laborers to place 300 cu.yd., one laborer would be required on a floor hopper, and four to move runways. So on a similar job using the buggy method, the organization would be as follows:

1 foreman at $1.00 per hour, per day	$8.00
1 hoisting engineer at $1.00 per hour, per day	8.00
1 mixer at $1.00 per hour, per day	8.00
1 laborer on sand at 60c. per hour, per day	4.80
2 laborers on gravel at 60c. per hour, per day	9.60
1 laborer on cement at 60c. per hour, per day	4.80
1 laborer on tower hopper at 60c. per hour, per day	4.80
1 mixer operator at 70c. per hour, per day	5.60
1 mixer helper at 60c. per hour, per day	4.80
15 laborers — buggies at 60c. per hour, per day	72.00
1 laborer, floor hoppers, at 60c. per hour, per day	4.80
4 laborers, runways, at 60c. per hour, per day	19.20
2 laborers, spreaders, at 60c. per hour, per day	9.60
	$164.00

With an average day's run of 300 cu.yd., the cost per yard for mixing and placing would be 53c. by using the buggy method with necessary crew.

Conclusion

Concrete gravity plants are machines for placing concrete at any point in a considerable horizontal area, at any elevation. Mobility and permanent construction are necessary if the machine is to be employed on several operations and this repeated use is essential to economy of plant investment. Proper installation, perfect maintenance and skillful operation are required for maximum production. These call for intelligent mechanical direction and experienced machine operators.

Testing Wearing Qualities of Shovels

Tests upon the various alloyed steels in order to determine the best steel to use for the manufacture of shovels have been carried on recently by the Wood Shovel & Tool Co., Piqua, Ohio. The tests determine not only the wear on the edge of the blade, but also the wear on the surface of the blade, the strength of the weld, toughness of the steel and the durability of the straps. The testing machine was designed with a rotating axle and four arms in which the shovels were fastened. The machine is driven with a 3-hp. motor with the speed reduced to 14 r.p.m. The shovels were forced through more than 3 ft. of red granite rock. Over 125,000 revolutions through the granite rocks, or a distance of more than 75 miles, were made by some of the steel shovels without the blades breaking or straps pulling loose. Based on the tonnage of material handled per shovel, this indicates that one shovel would have handled 3,400 tons.

Thirty Years' Engineering Service for District of Columbia

Asa E. Phillips, Resigning as Sanitary Engineer, Reviews His Work and Outlines Recent Difficulties

IN RESIGNING, effective Aug. 16, as sanitary engineer of the District of Columbia after thirty years' of engineering service, Asa E. Phillips presented a review of his work in the design and construction of sewers and sewage disposal works for the district and adjacent territory and in supervising, of late, the underground construction work of public service corporations. At the close of his review Mr. Phillips stated some of the difficulties he had met and the heavy burden he had carried in recent years because of a limited underpaid engineering staff. At the beginning of his letter of resignation, addressed to the engineer commissioner of the District of Columbia, Mr. Phillips stated that the present is a favorable time for him to resign, because of the excellent condition of existing works, the "limited outlook for new works" and the "lack of any appropriations for the sewage disposal system," and gave the condition of his health as a specific reason for resigning. He stated that he had served under 12 of the 16 engineer commissioners of the district, and that this was a longer term than that of any other department head in the district government. Mr. Phillips' review of his services is here given in full, as follows:

1891-1894—Principally subsurface surveys and large scale map construction of the drainage system of the district. This was the first set of 50' = 1" maps, followed later by the preparation of similar sets for highways, water mains and electric conduits.

1894-1898—Plans and estimates for new drainage works and construction of new works.

1898-1900—Rainfall and run-off studies, hydraulic data and experiments, including what are believed to be among the earliest studies along the line of what is now called the "rational method" of drainage computation; at the same time continuing the usual current work on new plans and carrying on construction work.

1900-1908—Engineer in charge of designs, estimates and construction for the sewage disposal system including the main sewerage pumping station and its mechanical equipment and all other works except the F St. interceptor and the Tiber Creek and New Jersey Ave. high-level interceptor, begun before this period.

Inception of Greater Sanitary District

1908-1921—Head of the sewerage division, engineer department, first as superintendent and later as sanitary engineer, including charge of underground construction of public service corporations. The work of this period has included studies and plans and partial construction of the enlarged sewage disposal system, from its original limits within the old city of Washington so as to include the entire district; and also the inception of a greater sanitary district, including those areas of Maryland which are a growing source of pollution of the park streams of the district.

It has included the expansion at the same time of the sewerage system to serve the outlying areas as far as the district line from Potomac Heights to Chesapeake Junction; this permitting the development of the many healthful and attractive suburban areas.

The supervision of underground construction of the public service corporations has been carefully organized along a systematic plan of location with accurate record sheets and mapping, under an equitable arrangement of cost construction with these corporations.

In the business and congested downtown area two important developments have been accomplished: The providing where required of deep service sewers independent of the ordinary combined storm and sanitary system, for important business structures with the cost borne entirely by the properties benefitted; and the mapping on a very large scale, from careful subsurface surveys of all underground construction, making a set of model charts whereon in appropriate colors these intricate structures are accurately set forth. In these particulars Washington has set a standard not attained, it is believed, by any other American city, and both without any additional expenditure of public funds.

The maintenance of a sewerage and drainage system in which $20,000,000 is invested is a very important work. In 1908 was first inaugurated a complete annual inspection of the interior of all trunk sewers with systematic and thorough recording of all structural defects, accompanied by a continuous inspection of the smaller lines. This work, involving the detailed examination of 700 miles of sewers, is so arranged and timed as to require only the services of the normal force by utilizing its period of seasonal winter inactivity. One of the first fruits of this new work was the detection of the impending failure of the great 30-ft. span Tiber sewer under the heavy Union Station Plaza fill and the prompt reconstruction of this great storm sewer by day labor forces working from the interior without surface excavation narrowly averted what would have been a serious disaster. Regularly these inspections are followed up with prompt repairs throughout the system.

Division Lacks Technical Personnel

Much of the drainage system of the District of Columbia, as it now exists, is fragmentary and incomplete, the result of growing inadequacy in the allotment of funds. The work done has been carried on under great and increasing difficulties due to the impossibility of maintaining a capable personnel with the meager rates of compensation allowed for technical assistants. There was a time, years ago, when four of the six or seven major engineering colleges of the country had graduates in responsible charge of work in this division; with a number of graduates of the minor colleges also; today, the sanitary engineer does not have as assistants a single graduate from the major colleges of engineering and has only two assistants with any engineering degrees. It is not at all intended to indicate that the grade of the institution determines the capacity of the graduate, yet the situation as set forth in a work whose technical detail is of primary importance, involves a danger that should not be overlooked, and has resulted in a great and unreasonable burdening of the sanitary engineer. How great may be measured by the fact that there is not a single drawing involving any elements of engineering design on the records of this department for very many years past which covers construction work costing more than $10,000,000 and involving structures of every sort, simple and complex, which has not been worked out in detail personally by the sanitary engineer.

With his supervisory duties involved in the design, construction, maintenance and operation of a very large and somewhat complicated drainage and disposal system, to say nothing of the inception and development of projects, the preparation of estimates and the administration of sewerage appropriations, the lack of technical assistance in this tedious and time absorbing detail has been an added burden that for years past has strained him beyond reasonable limits. An example of this manifest deficiency is found in the drafting force where the highest annual salary allowed is $1,200, or a rate of about $4 per day, less than the rate allowed pick-and-shovel men in the trenches. With such rates of pay it is manifestly impossible to secure men capable of performing the services demanded by the work involved.

In conclusion I desire to express my appreciation of the earnest and sincere labors of the entire personnel under my direction; in some instances they are rendering a service unexcelled in any other like organization and entirely disproportionate to the compensation allowed them.

Engineers Seek Data on Pressure Tunnel Construction

Committee Appointed by Swiss Railroads Investigating Causes and Remedy for Failure at Ritom Plant

Prof. A. Rohn of the Zurich Polytechnic College, one of the five members of a committee of engineers appointed by the Swiss Federal Railroads to investigate the failure of a pressure tunnel at the Ritom hydro-electric plant in May, 1920, has requested the "Engineering News-Record" to publish a questionnaire, and explanation, that the committee has addressed to hydro-electric plants and their engineers in various countries, regarding pressure tunnel construction. The subject will readily be recognized as important and one in which an international effort to secure information should be valuable. It is requested that replies be addressed to F. Rothpletz, Spitalgasse 24, Berne, Switzerland, chairman of the committee of experts appointed by the Swiss railways.—EDITOR.

NEAR the St. Gothard line the Ritom hydro-electric power station was erected by the Swiss Federal Railroads, designed to supply power for electric traction on this line. In May, 1920, the pressure tunnel carrying the water from the Ritom Lake to the pressure pipe line was filled for the first time and was found to be leaking. The internal water pressure is 54 lb. per sq.in. at the upper end, 65 lb. per sq.in. at the lower end of the tunnel. Some days after it was filled several springs began to flow on the mountain slope just outside the tunnel, where water had never been previously observed. A few days later, an earth slide occurred at another section of the slope, threatening the pipe line. Where the earth slide had started, several springs appeared. When the tunnel was emptied, all the springs ceased at once to flow, and it was therefore evident that it was not tight. The tunnel and water chamber are completely lined with concrete, with a smooth, water-tight cement finish, according to the statement of the committee of experts appointed by the Swiss railroads to study the subject. A thorough inspection of both revealed a great number of very small cracks which were for the most part longitudinal.

The investigating committee has stated that the quality of the concrete used for lining the tunnel was good and that the smooth cement finish of the lining had been well applied and had set very well; that the concrete lining had been brought close to the rock and that in all places where cavities between concrete and rock could be expected the cavities had been "mostly filled with cement grout." The cracks and leakage in the tunnel and water chamber could not, therefore, be attributed to faulty construction, according to the committee, since water could have gone only through these cracks. It is concluded that there are causes leading to the formation of cracks which have not hitherto been sufficiently known, as, for instance, a certain yielding of the rock.

In order to avoid a long stop of the entire plant, all the cracks were sealed and the tunnel again put into service, but the pressure at the lower end had to be kept within 14 lb. per sq.in. From that time until the committee sent out the questionnaire no further leakage has occurred.

The pressure tunnel of the Ritom power station is about 5,800 ft. above sea level and is 2,800 ft. long on a grade of 0.7 per cent. It passes along the mountain side, but lies at least 133 ft. under the rock surface. The rock through which the tunnel is cut consists mostly of small-banked, rather soft mica schist and very micaceous gneiss. The inclination of the strata is about 45 deg. and it crosses the axis of the tunnel at an angle varying between 30 deg. and 60 deg.

In view of the fact that the Swiss Federal Railroads are constructing other similar tunnels and will have to construct more of them in the future, the general management has appointed a committee of experts, which has issued the following questionnaire addressed to engineers and others associated with the design, construction and operation of other hydraulic pressure tunnels:

1. When was the tunnel built and how long has it been in service?
2. What is the length of the tunnel or shaft?
3. What is the grade of the tunnel (give longitudinal profile if possible) and what is the highest and lowest water level?
4. What are the minimum and maximum pressures in the tunnel or shaft in pounds per square inch?
5. What is the cross-sectional area of the tunnel or shaft in square feet?
6. State method of construction and whether or not tunnel is lined with masonry. (Supply sectional drawing if possible.)
7. What is the thickness of the lining? What is the material used? How was it applied and what cement was used?
8. Has the thickness of the masonry been fixed in accordance with the internal pressure? What conditions have been assumed to exist? Has any particular assumption been made as to the yielding or the elasticity of the rock?
9. Is the masonry close to the rock or are there cavities between the rock and the lining of the tunnel, which are only filled with dry stone packing or not filled at all?
10. Have such cavities been filled with cement grout during or since construction of the tunnel? Under what pressure was this grouting done?
11. Does the tunnel penetrate earth or rock? If rock, what kind (marl, limestone, conglomerate, gneiss, granite or any other kind of stone) and condition (homogeneous, stratified, cracked, water-tight or porous)?
12. Does the tunnel follow a mountain slope or cut through a mountain range? What are the longest and shortest distances between the gallery and the rock surface, vertically and horizontally?
13. What angle does the axis of the tunnel form with the drift of the strata? What is the inclination of the strata to the horizontal plane?
14. Have influences been observed due to the position of the tunnel relative to the stratification of the rock?
15. Are there certain parts of the gallery not lined at all with masonry, and has anything been done in these parts to make the rock water-tight?

Since not only the Swiss Federal Railroads have become greatly interested in this inquiry but also all power companies engaged in the construction of such tunnels, it is hoped by the committee that other engineers will assist them by replying to the questionnaire, giving as much information as possible. The committee consists of F. Rothpletz, chairman, Spitalgasse 24, Berne, Switzerland; Prof. M. Lugeon, Department of Geology, University of Lausanne; Prof. A. Rohn, Department of Civil Engineering, Zurich Polytechnic College; J. Büchi, consulting engineer, Zurich; and Prof. E. Hugi, Department of Mineralogy, University of Berne.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Waddell on Bridge Economics

Reviewed by CHARLES EVAN FOWLER
Consulting Engineer, New York City

ECONOMICS OF BRIDGEWORK: A Sequel to Bridge Engineering—By J. A. L. Waddell, C.E. (Rens. Poly. Inst.); B.A. Sc., Ma.E., D.Sc. (McGill Univ.); D. E. (Univ. of Neb.); LL.D. (Univ. of Mo.); Kogakuhukushi (Doctor of Eng., Imp. Univ. of Japan.) New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 512; illustrated. $6. 30s. net.

Here is a volume which should be read by engineers connected with the design and construction of bridges not because any will necessarily agree with the findings in all respects but as a stimulus to the serious consideration of what constitutes the real economics of bridgework. Many engineers will dispute the statement that the solutions given are the real and final ones. The author decries the mathematical methods of determining the economics of bridges, but it would seem unwise to give the young engineer the idea that he can do otherwise than depend largely upon pure mathematics as the foundation for conclusions built up of his practical experience. Yet the range of the author's investigations is remarkable.

The specific cases of the economics of large bridges referred to in the second chapter may be regarded as only suggestions of the various phases that must be considered in any great bridge project, but it would perhaps have been more valuable to the engineer had it been pointed out that there are certain fundamental considerations which take precedence over elementary bridge economics. Traffic needs, foundation conditions and existing land communications are among the determining factors in the construction of long spans. The chapter on alloy steels, a review of the author's various papers, provides information in condensed form. Unfortunately, his investigations of the possibilities of alloy steels have so far been fruitless, due principally to the fact that no philanthropic steelmakers have been found who will supply such alloys at costs which will make their use possible for long-span bridges.

The findings as to the use of tunnels instead of bridges will be much criticised by those who have investigated this subject, as the decision in any particular case must usually be made upon other considerations than those of economics, namely the results to be obtained and the practicability for the particular traffic to be carried, such as automobile traffic, which certainly cannot satisfactorily nor safely be carried through long tunnels. The question of comparative cost can only be decided by actual plans and estimates for each particular location, as so many local matters must be considered which vitally affect the cost of either bridge or tunnel. Indeed, elsewhere the author frequently admits that there are reasons for entirely disregarding the question of cost economy, as is done in the very short chapter on steel versus reinforced-concrete bridges.

The economics of the various ordinary types of steel structures and of pin-connected versus riveted types, are too well understood after years of development to warrant more than the meager eight pages devoted to the subject; most engineers will decide the major problems of such ordinary spans by judgment. The subject of the economics of continuous bridges has been so well understood for many years that no surprise need be expressed as to the results in favor of such construction where the conditions are at all favorable.

Cantilever bridges for comparatively short spans may usually also be dealt with on general grounds, as they are simply special forms of the continuous truss and should often be used where the possible settlement of piers will be large, or else where falsework for erection is very expensive or impossible. However, for long spans, where we have only two types to consider, the cantilever and the suspension bridge, the question of their comparative economy is a subject of fundamental interest, and it is to be regretted that the author did not discuss the question in its broad aspect, instead of upon personal grounds.

Certainly it is not *a priori* to be conceded that unloaded backstays are always the most economical; in a recent design for an 1,800-ft. suspension span, loaded backstays were found most economical for one end and uneconomical for the other end. The span of equal cost will likely be found, in comparing cantilevers and suspension bridges for any particular case, to hover closely around 1,700 or 1,800 ft., varying somewhat with the particular designs compared; for example, a wide difference will be found for a suspension design with fixed towers and one with hinged towers. These questions must all be decided "upon the broad grounds of professional intelligence and common sense."

Chapters 15 and 16 require but little comment except to question the declaration of the author against the use of ultimate maximum live loads and high unit stresses. It is to be regretted that the American Railway Engineering Association did not have the courage of its convictions and adopt an E 80 or E 90 live load, with unit stresses approaching closely the elastic limit; such a method is apparently the only logical way to build for the future, especially in case of long-span bridges.

In connection with what the author says on the economics of steel arch bridges it is pertinent to recall that a discussion of this subject before the American Society of Civil Engineers contained a tabulation of the design elements of 100 steel arches in various countries from which was derived a composite opinion of their various designers concerning economical rise and rib depth as well as type of arch. On the basis of this table the author thereupon admitted errors in his previous conclusions; but after making some trial designs he finally admitted only a partial agreement with the composite opinion of arch designers. Inasmuch as every large arch bridge is of necessity a special problem, it would be wise for each designer to satisfy himself as to whether this composite opinion, and Prof. M. A. Howe's findings as to the economy of the various types of arches, are correct or not. Further, each designer will find it advantageous to modify the

author's diagrams of weights to agree with his own practice, not only in this case but also in the case of many other diagrams in the book.

While the writer has found it desirable to extend this system of composite opinion to other types of bridges, particularly when dealing with the questions discussed in chapters 27 to 30, such matters as wire cables *versus* eyebar cables must be decided by accurate estimates and a careful consideration of all phases of the problem for each case, especially considering the grades of wire and alloy steels obtainable. Certainly an analysis of the author's findings on these points is far from satisfying.

The incentive to thought on types of movable bridges, afforded by Chapter 31, is somewhat neutralized by the succeeding chapter on the transporter bridge, as few will concede it the importance of requiring nearly a score of pages for its consideration, and most engineers will advise its avoidance like a plague.

A proper profit-sharing contract is no doubt conducive to economy; but while many are using a method in which cost plus a fee with bonus and penalty is giving good results, few will care to overload such a method with so much detail as to make it disagreeable in operation.

The chapters on Inspection, Shopwork, Erection, and Maintenance and Repair are well worth while and will give the young engineer a large amount of valuable practical information. The chapter on military bridges is timely, and the thanks of the profession are due to Gen. Beach and to Col. Bond for its preparation.

Careful survey of the volume compels the conclusion that a treatise on bridge economics is yet to be written. Such a work would give all the principal mathematical deductions as to detail design deduced by scores of independent engineering mathematicians; the practical application of these conclusions in the many long-span bridges already designed or built; and a series of comparative designs made upon a basis truly comparable. The opening or closing chapters of such a book should give a comprehensive review of the broader aspects of bridge planning, from both the economic and artistic point of view and with regard to traffic and other practical objectives.

British Experiments on Bridge Impact

TESTS ON RAILWAY BRIDGES IN RESPECT OF IMPACT EFFECTS—Report to British Ministry of Transport by Advisory Committee for the Revision of the Board of Trade Requirements, 1914; in Regard to the Opening of Railways. London, England: His Majesty's Stationery Office. Paper; 8 x 13 in.; pp. 10; many tables, folding plates and other illustrations. 15s. net.

In revising the British Board of Trade requirements concerning railway construction, an advisory board appointed for the purpose in 1914 gave the subject of bridge impact special consideration, through a subcommittee. After taking into account American practice in making impact allowances on live load, the variation of English practice, and the recent active discussion of the subject among the engineers of the Indian railways, the committee first considered the adoption of the Pencoyd formula, but later decided to undertake a series of experiments. The results of these experiments are recorded in the present report. Twenty bridges were tested and 181 runs made, giving 362 records. The Fereday-Palmer photographic stress recorder was used, an instrument which, because of its construction, has very little inertia. The diagrams show remarkably interesting vibrations of relatively high frequency, that are neither natural vibrations of the girders nor proper motions of the recorder parts, according to the author of the report, Maj. A. Mount, Inspecting Officer of Railways. The vibrations, which show chiefly in bottom-flange records, vary in frequency from about 30 to 70 per second. They are attributed to definite variation in stress in the member due to the application of live load. On the basis of the experiments, combined with those made earlier by the American Railway Engineering Association, a new formula, similar to the old A. R. E. A. formula, with 120 in the numerator and 90 in the denominator, is recommended. A fuller abstract of the tests and conclusions will be given in *Engineering News-Record* shortly.

Automatic Sewage Ejectors

REVIEWED BY JOHN H. GREGORY

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THE EFFICIENCY OF PUMPS AND EJECTORS—By E. C. Bowden-Smith, M. I. Mech. E., Late Egyptian Civil Service, Author of "Oil Firing for Kitchen Ranges and Steam Boilers," etc. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 205; illustrated. $5.

If the title leads anyone to expect that this volume is a short treatise or textbook on the efficiency of pumps and ejectors he will be disappointed. To a large extent the book is a monograph on the use of the automatic sewage ejector, written apparently as the result of the author's personal experience on the main drainage ejector system of Cairo, Egypt.

The author does give some data on the efficiency of certain pumps and ejectors which have come under his personal observation, but these data are extremely meager and so presented as to be of little value to the engineer. Although English units are used largely throughout the book, yet in places units not easily grasped by the American engineer are employed. For example, the volume of sewage is sometimes given in cubic meters and costs in Egyptian pounds.

The book is clearly printed, but not well illustrated. The line sketches, which are few, are of practically no value, and but little more can be said of the diagrams, which are poorly arranged and drawn.

Notwithstanding the lack of real working data on the efficiency of pumps and ejectors, the author has written an admirable general discussion of sewage ejectors, well worth careful reading by any engineer who has under consideration the installation of such ejectors on an extensive scale.

Railway Track Maintenance

ROADWAY AND TRACK—By W. F. Rench, Author of "Simplified Curve and Switch Work," Formerly Supervisor on Pennsylvania Railroad. New York: Simmons-Boardman Publishing Co. Cloth; 6 x 9 in.; pp. 242; illustrated. $3.

A good practical book for the supervisor and roadmaster and for the engineer who has to do with maintenance of way. To the experienced man it will give new ideas, besides refreshing his memory as to matters he should know and has forgotten. To the younger man it gives both information and instruction. The term practical is used advisedly, because there is little in regard to theory, principles or development, the book dealing mainly with present-day conditions of routine and special classes of maintenance work, which are described fully and clearly.

Omission of instructions as to turnouts, switch work and even such an important subject as superelevation on curves may be due to the treatment of

these matters in another book by the author. Not much is said about track material or tool equipment—particularly power-operated tools. As to the labor problem, the author deals with the present condition of inefficiency and independence. He advocates the modern idea of distributing track work throughout the entire year in order to maintain uniform and competent forces. An inadequate and illogical index is a marked defect for which the publisher must share the responsibility.

Great Lakes and Niagara River Diversion

DIVERSION OF WATER FROM THE GREAT LAKES AND NIAGARA RIVER: Letter from the Secretary of War Transmitting, with a Letter from the Chief of Engineers, Reports by Col. J. G. Warren, Corps of Engineers, and the Board of Engineers for Rivers and Harbors, on Water Diversion from the Great Lakes and the Niagara River, Including Navigation, Sanitary, and Power Purposes, and the Preservation of the Scenic Beauty of Niagara Falls and the Rapids of Niagara River. Washington, D. C.; War Department. Paper; 6 x 9 in.; pp. 415; 57 plates.

Niagara Falls is a combined scenic and industrial heritage to the people of Canada and the United States. Its scenic beauties have long been foremost. Twenty years or so ago its value as an industrial asset began to be realized. We are now in the beginning of the great controversy sure to be waged in the coming generation between the two values of the Falls. In that controversy the report to the Secretary of War, noted in the above heading, should be a valuable base mark, for in it is gathered together probably for the first time the full information regarding the hydraulics of the Niagara River, the possibilities of power development upon it, the effect of the diversions from the river and from its reservoir, the Great Lakes, upon both power and scenic beauty, and finally the recommendations as to future treatment which will preserve and possibly increase the scenic beauty, and at the same time provide for greater power development.

The main part of the report consists of an investigation by Col. J. G. Warren, Corps of Engineers, U. S. A., division engineer at Buffalo, and of W. S. Richmond, U. S. assistant engineer. Their reports are abstracted at considerable length by Gen. Harry Taylor, for the Board of Engineers for Rivers and Harbors.

The reports are much too lengthy for detailed description. They do contain practically everything that the engineer need know regarding the Niagara River and its reservoirs for his information in deciding upon treatment of the river. They contain an interesting recommendation that river protection works be placed above Niagara Falls better to distribute the water over the crest and to increase the scenic effect, at the same time permitting the diversion for power purposes of a considerably greater quantity of water than has ever before been attempted. They also contain the statement, interesting and novel, we think, to most engineers, that the present treaty agreement of 36,000 sec.-ft. to Canada and 20,000 sec.-ft. to the United States apparently is not based on any rational method of apportionment, but rather was devised to take care of developments existing at the time the treaty was made. The recommendation is made, however, that if proper remedial works are installed each country could readily divert 40,000 sec.-ft. without damaging the Falls, and the hope is expressed that 100,000 to 110,000 sec.-ft. total is possible.

The dozen pages of the report in which Mr. Richmond deals with the sanitary aspects of lake diversion are mostly filled with a valuable discussion of diversion of Lake Michigan water through the Chicago Drainage Canal to dilute the sewage of the district and protect the water supply of Chicago. The conclusion is reached that the conflict over diversion should be settled in the interests of all concerned, including 13 American states, Canada, Chicago and its Sanitary District, the shipping and the water-power interests. Elements of such a settlement are outlined. The remainder of this section touches upon the Black River Canal, for the dilution of the sewage of Port Huron, Mich.; the proposed Erie & Ontario Sanitary Canal at and near Buffalo, which is disapproved; and the diversion of water for the supply of Chicago and other lake cities.

Reinforced-Concrete Diagrams

CONCRETE DESIGNER'S MANUAL: Tables and Diagrams for the Design of Reinforced Concrete Structures—By George A. Hool,, S. B., Consulting Engineer, Professor of Structural Engineering, The University of Wisconsin and Charles S. Whitney, M. C. E., Structural Engineer, Milwaukee, Wis. New York and London: McGraw-Hill Book Co., Inc. Flexible; 6 x 9 in.; pp. 276; illustrated. $4.

It has been the fortune of the reviewer to sit many years at an editorial desk over which have passed numberless articles on the design and construction of concrete. As a result of his experience he ventures to guess that every engineer who has had to design more than three structures in which reinforced concrete figures has prepared a diagram for the simplification of future design. Further than that, probably two or three of them have submitted the diagrams for publication, with the comment that these particular diagrams are the only satisfactory ones the author has ever seen, though he has inspected and tried to use many. All of which shows that Messrs. Hool and Whitney have struck a popular chord in the preparation of the diagrams in the book noted above, though they may find a persistent preference for self-made curves.

The diagrams are extensive and inclusive and cover practically every possible phase of concrete design, with the necessary variations of unit stress and modulus of elasticity ration. The subjects covered are slabs, flat slabs (according to the American Concrete Institute and New York and Chicago codes but not the old Joint Committee), rectangular beams, doubly reinforced beams, T-beams, shear reinforcement, columns, bending and direct stress and footings. Reprints are given of the 1917 Joint Committee report, the A. C. I. building law recommendations and the Chicago and New York code requirements for concrete.

Concrete design diagrams depend for their value on their constant use and for such use many different methods of arrangement are equally satisfactory. The present diagrams are no exception to this rule; in addition, they have the great value of readability and easy access as well as general application.

Monthly Business Survey

A monthly "Survey of Current Business" is being published by the United States Department of Commerce. The data presented, according to a statement issued by Herbert Hoover, Secretary of the Department of Commerce, will consist largely of material "which the secretary and executives of the various departments find necessary to have at hand for their own use." Some of the data presented in the July "Survey" are classified under Banking and Finance, Price Index Numbers, Cost of Living, Transportation, Building Statistics, and Fuel

and Power, but there are twenty main heads altogether. The general scheme is to give index numbers for each year from 1913 to 1920 with the 1913 figures as the base. Besides these monthly averages by years, the corresponding figures are given by months for 1920 and up to and including June, 1921. In the introduction to the first "Survey", it is stated: "In comparing these figures every effort is made to secure accuracy and completeness. *On the other hand, it is realized that timeliness is often of more value than extreme accuracy.*" It is to be hoped that other government departments will note and heed the sentence we have italicized. The large percentage of government statistics published are so belated as to be of only historical interest.

A Broad View of the Engineer

THE ENGINEER—By John Hays Hammond. New York: Charles Scribner's Sons. Cloth; 5 x 7 in.; pp. 194. $1.75.

If the claims, qualifications and opportunities for service in other vocations are as well presented as are those of the engineer in the volume before us the books in this Vocational Series will be helpful to individuals choosing a career, to the various professions or other callings and to the public at large—which suffers largely from misfits.

The plan of Mr. Hammond's book is first to outline the profession of engineering, its advantages and—note this—its shortcomings; then to consider the natural qualities of an engineer and the abilities which he may acquire, his general education, his training in the use of English, and the foundations of engineering. This brings the author to a consideration of seven classes of engineers: the mechanical, civil, mining, electrical, chemical, marine and the military. A brief summing up closes the book.

The author takes a broad view of the engineer, his educational needs and his place in the world's work. In his concluding chapter he forcibly presents the increasingly great part that the engineer will take in government—"a vast engineering undertaking, in which fitness and integrity of men are fundamental necessities." Besides being admirably adapted to serve as an aid in the choice of a vocation, Mr. Hammond's book should be of value to engineering educators and cannot fail to interest every wide awake engineer.

PUBLICATIONS RECEIVED

AMERICAN RAILWAY MOTIVE POWER DEPARTMENT AND FUEL ORGANIZATIONS—By H. L. Cole, O.B.E., M.I.Mech.E., Locomotive Department, Indian State Railways and Secretary, Railway Board. Simla, India: Chief Engineer with the Railway Board. Paper; 8 x 13 in.; pp. 29; illustrated.

THE BRITISH CAST IRON RESEARCH ASSOCIATION: A Survey of the Scheme of Industrial and Scientific Research for the Cast Iron Foundry Industry. Birmingham, Eng.: The Association. Paper; 6 x 9 in.; pp. 24.

CHARTER, ORDINANCES AND LAWS, CITY OF WALTHAM, MASS, 1921—By Order of the City Council. Waltham, Mass.: The Council. Cloth; 6 x 9 in.; pp. 298.

THE CITY PLAN AND LIVING AND WORKING CONDITIONS—By John Ihlder, Manager, Civic Development Department, Chamber of Commerce of the U. S. Washington, D. C.: The Author. Paper; 5 x 8 in.; pp. 15.

CONCRETE PAVEMENT CONSTRUCTION IN HOT WEATHER—New York and Chicago: Portland Cement Association. Paper; 6 x 9 in.; pp. 12; illustrated.

DIENST VOOR WATERKRACHT EN ELECTRICITEIT IN NEDERLANDSCH-INDIA, 1919—Bendoleng, Java, W. I.: Address P. A. Roolofsen. He Hoofd von den Dienst voor Waterkracht en Electriciteit. Stiff paper; 7 x 10 in.; pp. 32; half tones and folding maps.

EIGHTH NATIONAL FOREIGN TRADE CONVENTION, CLEVELAND, 1921—New York City: The Secretary, India House, Hanover Square. Cloth; 6 x 9 in.; pp. 628. $2.50.

THE EMPIRE MUNICIPAL DIRECTORY AND YEAR BOOK—1921-22. Comprising England and Wales, Scotland, Ireland, Canada and Newfoundland, India, Burma, Ceylon, Australian Commonwealth, New Zealand, Africa * * * * * and Other Dependencies and Colonies. 39th Year of Publication. London: The Sanitary Publishing Co., Ltd. Cloth; 7 x 10 in.

In three parts: (1) the directory, giving populations and the leading appointive administrative officials for the cities and lesser governmental units of all the countries in the British Empire; (2) a review, for the year 1920, of the progress and status of municipal public works and services, such as road construction, use of motor vehicles, sewerage and sewage treatment, refuse collection and disposal; housing and town planning; (3) "A Municipal Engineering and Sanitary Engineering Trades Directory." Leading officials of the government departments of Great Britain, Canada, India, etc., and the headquarters and secretaries of various municipal and technical societies are given. For easy reference the directory part would be much improved if the divisions for each country were combined in a single list, instead of being given separately under from two to a half-dozen classifications.

FIRE RESISTANCE OF CONCRETE AND REINFORCED CONCRETE—Reports of tests by a Special Commission of the British Fire Prevention Committee. Red Books of the Committee. Paper; 5 x 9 in.; Nos. 217, 219 and 221, about 32 pp. each and No. 251, 64 pp.; illustrated. London, England: H. M. Stationery Office. Postpaid, 2s. 6d. each.

No. 217: Cement Concrete Floor Slabs of Broken Stock Brick, Sand (or Stock Brick Fine Stuff) and Portland Cement in Various Proportions with Some of the Slabs Having a Protective Covering on the Soffit.

No. 219: Cement Concrete Slab Floors of Coke Breeze, Broken Stock Brick, Furnace Clinker, Sand (or Fine Coke Breeze) and Portland Cement in Various Proportions.

No. 221: Reinforced Concrete Floors of (1) Clinker and (2) Coke Breeze.

No. 251: Heat Conductivity Tests with Concrete Slags of Various Aggregates (Thames Ballast, Coke Breeze, Limestone, Granite, Gravel, Slag, Etc.) in Various Proportions.

Some of the latest detailed reports on a long series of tests made possible by a grant, early in 1917, from the Government Department of Scientific and Industrial Research to the British Fire Prevention Committee. Some thirty Red Books on these tests have been prepared. A full list may be obtained from the department just named, 16 Old Queen St., Westminster, London, S. W. 1, England, but for purchase of the reports, address H. M. Stationery Office, as above.

FORESTRY COMMISSIONERS OF UNITED KINGDOM—Report for 1919-20. London, England: H. M. Stationery Office. Paper; 6 x 10 in.; diagrams. 9d. net.

Reviews the history of forestry in the United Kingdom and details beginnings of state forestry under the Forestry Act, 1919. The commission has acquired 103,100 acres of land, of which 68,100 are plantable; planted 1,585 acres in the eight months ended Sept. 30, 1920; made out a program for 1920-21 to plant 8,000 acres; has established nurseries; and has arranged for educational work in forestry.

GAUGE WEIRS FOR STREAMS—By H. J. F. Gourley, M. Eng., Assoc. M.Inst. C. E., F.G.S. Read and Discussed at the Institution of Water Engineers, June, 1921. London: The Institution. Paper; 6 x 9 in.; pp. 10; illustrated.

HYDROMETRIC SURVEYS: Provinces of Alberta and Saskatchewan, 1919—Ottawa, Can.: Department of the Interior. Paper; 7 x 10 in.; pp. 391.

MERCHANT VESSELS—By Robert Riegel, Ph.D., Professor of Insurance and Statistics in the University of Pennsylvania. (Shipping Series.) New York: D. Appleton & Co. Cloth; 6 x 9 in.; pp. 257; illustrated. $4 net.

An economic presentation of the subject for the student and business man. Types of vessels and of construction, together with means of propulsion, are considered in Part I; Part II is devoted to ship measurement. The treatment is concise. Useful reference lists are appended to each chapter.

NATIONAL CONFERENCE ON CITY PLANNING—Proceedings for 1920. Boston: Flavell Shurtleff, Secretary, 60 State St. Cloth; 6 x 9 in.; pp. 165.

Contains papers on city planning work in St. Louis, Detroit, Dallas, Rochester, Cleveland, Cincinnati, and on zoning and other subjects.

NEW JERSEY DEPARTMENT OF HEALTH: Report, 1920—Trenton, N. J.: The Department. Cloth; 6 x 9 in.; pp. 381.

OSSERVAZIONI PLUVIOMETRICHE: Raccolte Nel Bacini Con Foce Al Litorale Della Compania, 1916-17; pp. 76: Raccolte Nella Sicilia. 1916-17; pp. 100. Rome, Italy: Ministero Dei Lavori Pubblici. Paper; 13 x 9 in.

RESURFACING AN OLD PAVEMENT WITH CONCRETE: South Seventh Street Road, Vigo County, Terre Haute, Ind.—New York and Chicago: Portland Cement Association. Paper; 6 x 9 in.; pp. 7; illustrated.

SEWERS AND SEWERAGE: Sewage Estimates and Sewerage Requirements, The Components and Operation of Sewers, The Design and Execution of Sewerage Schemes—By H. Gilbert Whyatt, Member of the Institution of Civil Engineers; Member of the Royal Sanitary Institute; Member of the Institute of Municipal and County Engineers, etc. New York and London: Isaac Pitman & Sons. Cloth; 4 x 6 in.; pp. 118; illustrated. $1. Brief outline of the elements of the subject, from the British viewpoint.

THE STORY OF ENGLISH PUBLIC HEALTH—By Sir Malcolm Morris, K.C.V.O., Member of the Royal Commission on Venereal Diseases, and of the Executive Committee of the National Council for Combating Venereal Diseases; President of the Institute of Hygiene; Fellow of the Royal Sanitary Institute, etc. New York: Funk & Wagnalls Co. Cloth; 5 x 8 in.; pp. 166. $1.50.

THE USE OF POWDERED FUEL UNDER STEAM BOILERS: Presented Before American Iron and Steel Institute, May 27, 1921, by H. D. Savage, M.A.S.M.E., A.I.M.E. New York: Combustion Engineering Corp. Paper; 6 x 9 in.; pp. 41; illustrated.

WHO'S WHO IN ENGINEERING—Edited by John Ed. Sears, C.B.E., M.A., Assoc.M.Inst.C.E., 1920-21. London: The Compendium Publishing Co. Cloth; 7 x 10 in.; pp. 426. Covers British engineers, societies, schools, journals and manufacturers.

LETTERS TO THE EDITOR

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

Views on American and European Bridge Construction

Sir—I have received your letter asking my opinion on the article by P. H. Chen, Engineer Chinese Government Railways, on certain tests alleged to have been made by him on steel bridges in China, published in your issue of July 14, p. 58. I have also read your editorial thereon. The article reminds me of the story about the discussion by some savants of the proposition: Why does a bowl brimful of water, into which a goldfish is dropped, not overflow? After some learned explanations all around, a hardheaded Scotchman finally opinioned "I dut the fact."

I would suggest that Mr. Chen first produce some proof of the remarkable differences in deflection in bridges, which he reports in your journal. G. LINDENTHAL.

New York City, July 19.

Sir—The paper by P. H. Chen in your issue of July 14 brings up an interesting subject for consideration. The statement about the effect produced on bridges by American rolling stock is based on one test which was made with admittedly crude instruments. Nothing is said about the condition of the engines used in the test. Defective rolling stock with loose brasses, flat wheels and similar defects could easily increase the vibration and account for the observed differences.

Two errors are noted in the paper: The lateral vibration given for engine 153 as 11.5 m.m. does not agree with the description [it should read 1.5 mm.—ED.] The bridge diagram shows a length of 154 ft. and the table states 114 ft. span [the latter is in error.—ED.]

The paper might have contained valuable data about the two bridge accidents mentioned. Were the bridges overloaded? Had there been any settlement to produce unusual stress? Evidence of this kind is desirable before blaming the failure on the use of American locomotives.

It seems unfortunate that *Engineering News-Record* did not investigate the subject thoroughly before making editorial comment. Communication with the special committees of the American Society of Civil Engineers on bridge design and railroad track stresses would have furnished better data upon which to base an opinion. An editorial from a generally accepted authority like *Engineering News-Record* may produce an unfortunate effect on the casual or hasty reader and will doubtless prove serious to our export business. Imagine an American locomotive exporter confronted by the following quotation from the editorial when trying to make a sale in a foreign country: "An experiment is rcorded which shows that an American locomotive set up lateral vibrations in a bridge several times as violent as those set up by a European locomotive."

Should such statements be published without first carefully investigating the causes and the accuracy of the deductions? ROBERT A. MARSHALL,

New York City, July 20. D. P. Robinson & Co.

Sir—The comparison of European and American bridges and loadings is very interesting, but the conditions found are susceptible of easy explanation. The European type of bridge shown in cross-section would hardly be called good engineering in any country, as it leaves the wind stresses and other lateral forces or vibrations a chance only to "shin down" the posts. The reason for the slight changes in European designs is the fact that there has been no such increase in locomotives and train weights as has occurred in America.

The usual depth of our bridge trusses years ago, with the light loads then existing, was about one-seventh of the span length, but with the advent of modern train loads we quickly changed to depths of about one-sixth, for stiffness and economy. The table given by Mr. Chen is quite remarkable in that he found practically no increase in impact for increase of speed, as is sure to occur up to the critical speed, and such results are undoubtedly due to the use of crude instruments.

What the author notes as "severe shaking" was probably a combination of deflection and lateral vibration, giving a cork screw motion, which is sure to be found in too shallow trusses having insufficient portal and cross-section bracing.

Detroit, July 21. CHARLES EVAN FOWLER.

Sir—The article "Railway Bridge Construction and Service by American and European Standards" is very interesting, and it is to be hoped that he will follow it with the results of the further investigations he promises, as he is in a better position to make comparisons than any of the contestants.

The author's tests show greater impact effects with the American locomotive than with the German, but the maximum of 31 per cent recorded is well within the limit of 46 per cent for which this span would be designed under American practice. It must also be borne in mind that the impact effects from derailed wheels, for which provision must be made, might exceed those caused in normal operation.

Impact effects and lateral vibrations are caused primarily by the unbalanced revolving parts of the locomotive together with slight additions for unevenness of track and defective wheels. The writer has run an electric train with balanced revolving elements over a 50-ft. span at all speeds up to 45 mi. per hr. without being able to detect any measurable effects of impact.

American bridges are designed to cover all conditions that can reasonably be anticipated. Bridges are destroyed by derailed trains, collisions on them, or something falling from the train. It is, therefore, obvious that the floor system, which must receive the initial shock, should be as heavy as practicable so that its mass will act as an anvil to cushion the blow. This accounts for the lower stresses used in designing such parts. The writer has built 100-ft. spans with three panels of 33⅓ ft. in order that a large part of the weight might be massed in the floor.

Our early designers failed to anticipate the great and rapid increase in the live load, and most bridges have been replaced when only a third of their normal life had elapsed on this account. The weight of the locomotive doubled in a period of about ten years. Now that the limit of weight has nearly been reached through the limit of space, future increase does not need to be provided for in the same measure, and higher stresses are being adopted and greater uniformity in the practice of different countries will result.

With regard to bracing, the vulnerable parts are the compression members. In these, sag or deflection is incipient failure, and liability to destruction by blows an especial source of danger, and the bracing necessary to protect them is a small percentage of the total weight of the bridge.

Bridge design is of such economic importance to the public, that the national government should provide investigations and tests similar to those by which armaments are developed, with the advantage that the results would be far less costly and of more permanent value.

New York City, July 22. GEO. H. PEGRAM.

Sir—Referring to the article by P. H. Chen, which I have read with considerable interest: It appears to me that the article has many general statements. It is hard to analyze and answer his questions.

A detailed study should be made of European bridge practice and American bridge practice. To say that a European-built bridge failed under an American locomotive which was lighter than the European locomotive does not mean much until all of the details of design and the character of the locomotives are known.

The American locomotive has outside cylinders, which make it diffcult to counterbalance, and consequently there is considerable nosing. This nosing means comparatively

large lateral forces compared with European locomotives with cylinders inside of the frame. The American locomotive, however, has many advantages in that it has its reciprocating parts on the outside. The whole question at last resolves itself into the basic problem of railroad engineering. Who hauls freight at the lowest cost per ton-mile, the Chinaman or the American? Bridgebuilding is a small item in economical freight handling. B. R. LEFFLER,

Engineer of Bridges, New York Central R.R. Co.

Cleveland, July 30.

Sir—Mr. Chen's article in *Engineering News-Record* of July 14 should be taken as a timely hint by Americans interested in exporting fabricated steel for bridges. It concerns fabricators and steel producers as well as designers.

American railway bridges are generally designed for typical loads and impact at maximum speed, with unit stresses so low that live loads about 50 per cent greater than the design load may be safely carried without restriction of traffic. In other words, if maintenance of physical condition has been good, we expect E50 bridges to remain in service, on lines of average density of traffic, until live loads approximately to E75 are introduced. If E75 loading were used for design, with unit stresses of about 21,000 lb. per sq.in., and the bridges designated as E75, questions concerning ultimate working loads would be simplified. Moreover, the web members, and particularly the counterbracing, would be more rationally proportioned.

Except for long spans, American practice has come to use mild steel exclusively, as it is more readily obtainable and makes for a standard commercial article. It is also better adapted to American shop practice, and the extra weight involved has been more than offset by low unit prices. In the early days of structural steel in America "medium" and "high" steel were frequently specified, sometimes three grades being used in one structure. For some export work, where freight and erection costs are comparatively high, with a consequent incentive to keep weights down, the writer believes that high-carbon and perhaps alloy steel should prove economical. He does not believe that impact is a serious factor in selecting the grade of steel; shop practice really determines it. There is some evidence that high-carbon steel, if not punished in fabrication, may stand impact better than low-carbon steel. When we have shops equipped to handle all-drilled work as economically as European shops are reported to do, then we can safely use high-carbon steel with a large saving in weights and, for many export jobs where freight and erection are high, considerable reduction in costs. Fabricators and steelmakers who are looking for foreign markets may find this point worth some consideration.

Nearly thirty years ago the late George S. Morison proposed, in outline, a four-cylinder balanced compound locomotive, designed to reduce impact to the minimum. The suggestion seems to have received little consideration from locomotive designers. The writer is not equipped to discuss its merits nor the point raised by Mr. Chen regarding the comparative impact effects of European and American locomotives, except to say that, if impact could be reduced as much as Mr. Chen's experiment indicates, an average saving of from 8 to 10 per cent in weight of bridges might be realized. As a general mechanical principle, it would seem to one without experience in locomotive design that impact and lateral forces, so destructive to track and structures, represent lost energy, and that the most efficient machine should be that in which the minimum percentage of the total power developed is expended in ineffective and destructive work—the smoothest running machine. The answer to this question from motive-power experts will be awaited with interest.

For overseas export work, pony trusses and latticed girders may often be used to advantage for span lengths which would be designed as plate girders for domestic use.

The "standard" cross-sections of 150-ft. spans shown in Fig. 2 of Mr. Chen's article are hardly a fair comparison. The American example given is hardly "standard" practice here; the top strut is much deeper than common and the truss depth is rather an extreme example than an average one. On the other hand, the European example only gives, apparently, about 18 ft. headroom, and the top laterals are much too slender for compression. A mean between the two would fairly conform to good practice. It looks as if the opposite extremes were being compared instead of average European and American practice. Although American bridge designs have tended, in recent years, towards quite rigid bracing, one would hardly suppose that we had gone beyond the English practice in this respect.

Finally, referring to Mr. Chen's specific questions, the following remarks may be made:

1. Have European bridges, generally, been subject to as rapid increases in live loads as have American bridges?

2. For American conditions, including the necessity for anticipating great and rapid increases in loads and low unit costs for fabrications and erection, American designers cannot justly be accused of wasting money, notwithstanding their bridges are comparatively heavy.

3. Chinese practice should be fixed for Chinese conditions, including costs of material, freights and erection, anticipated traffic and loads, maintenance conditions and other factors affecting the problem. A. W. BUEL.

New York City, Aug. 10.

A Plea for Research in Paint and Wood

Sir—Some months ago I was asked for advice as to the best treatment (by the maker) for automobile wood wheels to prevent absorption of moisture and subsequent shrinkage. No material help was to be had from the Forest Products Laboratory; and inquiry developed the fact that no agreement of opinion exists among the makers of wagons and trucks as to the most desirable moisture-content, the treatment with oil, either raw or boiled (linseed oil), character and amount of paint, temperature during such treatment, or anything else. This seems to be a matter deserving investigation by some government agency; especially, it seems to me, by the Forest Products Laboratory or possibly the Bureau of Standards, or both in co-operation.

But really this is only a particular case of the general problem of preservation of wood after it has been converted into structures, by painting, varnishing and the like. Most of the paint and varnish made in this country, which probably amounts annually to two hundred millions of dollars or more in value, is used on wood, and most of the people in the United States live in wooden houses, which depend on paint to resist decay and the action of the weather. Wood is itself practically imperishable. Mummy-cases two to three thousand years old exist; and in my own how town, Flushing, N. Y., there is a Friends' meeting-house, built in 1695, still in weekly use, and as good as ever, built of wood grown in the vicinity; and an excellent and valuable dwelling house, the Bowne house, also of wood, built in 1661. If a wooden house can be preserved two hundred and sixty years and still be as good, apparently, as when it was built, we are warranted in maintaining that a wooden house should be a permanent structure; and the present shortage of houses, with the high cost of materials and labor, justifies every reasonable effort for their preservation.

Not long ago the chief chemist of the Pennsylvania R.R. asked my opinion as to the cause of failure of some paint, prepared according to the specification of a well-known and highly recommended writer on the subject; and if the Pennsylvania R.R. cannot protect itself in this matter, what chance has the ordinary citizen with no special knowledge nor access to technical literature, but who wishes to preserve his homestead, representing probably the savings of years? About all he can learn is in the advertising matter of someone who simply desires to sell him a paint which will yield a good profit to the maker and the retailer.

Some of the paint manufacturers know a good deal about paint, but very little about wood. The Forest Products Laboratory knows a great deal about wood, but nothing about paint. With their knowledge of the structure and nature of different kinds of wood. and their natural and

professional interest in its preservation, the forestry people ought to be the ones to undertake this investigation and carry it on, with no commercial bias, for a term of many years. The only thing that hinders them, so they say, is the lack of money; they agree that they ought to do it and they wish to do it.

They think they can make a beginning with $6,000 a year; my own opinion is that they can, with probably some co-operation from the Bureau of Standards, but that after a year or two the amount will need to be a half more, and finally about double the specified sum. This should be public money, or at any rate not from a source which might imply an advertising value in the results; we have enough of that kind of research now. The Forest Service organization has done a great deal of good. It has always been above suspicion; let us keep it so. Those who are to be benefited are the whole people, not only of this country but the world. And whatever may be the necessity for economy in these days of housing shortage we ought not to refuse this small amount for a service which may eventually double the whole value of the forestry work. Will those who read this and approve do something about it?

Flushing, N. Y., Aug. 5. A. H. SABIN.

Fire Resistance of Columns

Sir—R. E. Wilson's digest of the test investigation of the fire resistance of building columns conducted at the Underwriters' Laboratories emphasizes the excellence of this series of tests and sets forth some fundamental data on the fire resistance of different types of column protectives. In this latest contribution to the art of fire-resistive construction, some discrepancies have developed from existing practice based on the results of actual fires and previous test investigations made for supervising building authorities.

The Bureau of Buildings of New York was the pioneer in establishing requirements for fire-resistive construction, based on actual test investigation on floor and partition construction and column protection. As far back as 1903, tests were made on some nine different types of column protection by Rudolph P. Miller, then chief engineer of the Bureau of Buildings, Borough of Manhattan. These tests were not made to establish relative values, but to determine the minimum requirements for a protective coating on structural columns which would insure safety for a reasonable length of time against the action of fire. The test specifications then established required the coating to withstand the action of a 1,700-degree F. fire for a period of 2 hr., without permitting the temperature of the structural shaft to rise over 550 degrees F. This specification was adopted and incorporated in the city building code on Oct. 6, 1915. Several column constructions were also tested from time to time in conjunction with standard fire, water and load tests on new types of fireproof floor fillings. Among other materials, it was found that both gypsum and cinder concrete, although somewhat deficient in structural strength, gave excellent fire protection to steel and cast-iron columns, and both of these types of protection have been accepted and are approved for column protection under the building code of New York in so-called fireproof buildings when applied in 2-in. thickness.

From the ratings based on the underwriters' tests it will be noted that a 2-in. gypsum protection would not meet the 2-hr. requirement. Furthermore, a 2-in. protection of hard-coal cinder concrete is grouped with granite and sandstone concretes, with a maximum rating of 2½ hr. In the New York tests cinder concrete has always shown superior heat insulating properties and less tendency to crack and spall under expansion and contraction than most other concretes, and gypsum gave the lowest temperature of conduction of all the protective coatings.

The lower rating of these materials in the underwriters' tests can, possibly, be traced to the construction of the test specimens. In these tests the protective coating on the steel or cast-iron shaft was required to support a portion of the load, the head of the column shaft being subjected to direct compression on the total area of the finished column with the covering. This detail is not followed in ordinary practice, where the coating is simply a protection to the structural shaft, except in the case of reinforced-concrete construction, where shaft and covering are cast monolithic. The load is ordinarily applied to steel or cast-iron columns through the medium of cast or riveted brackets supporting the ends of the girders. In the underwriters' tests, as the metal of the column became heated, a constantly increasing proportion of the load was transferred to the covering. As gypsum and cinder concrete, for example, possess lower compressive strengths than other coatings, the duration of time to failure of the column shaft would naturally be decreased, not considering the other factors of expansion, spalling and heat conductivity.

The average compressive strengths at one month of the various protective materials are given in the appendix to the complete report of the underwriters' tests as follows:

Protective Material		Compressive Strength Lb. per Sq.In.
1:2:4	silicious gravel concrete	1,807
1:2:4	sandstone concrete	1,633
1:2:4	limestone concrete	1,588
1:2:4	calcareous gravel concrete	1,505
1:2:4	trap-rock concrete	1,497
1:2:4	granite concrete	1,263
1:1½:4½	cinder concrete	989
1:2:5	cinder concrete	771
Gypsum blocks (on edge)		468

The excellent results obtained with the unprotected timber columns were to be expected. Although the area of the shaft was reduced from 25 to 55 per cent the tests did not develop the full resistance of the column shaft to the action of fire. Failure was due to the metal cap bearings, through conduction of the heat in the metal flanges and the metal bearing plates. By the introduction of properly protected caps, or such reinforced-concrete caps as are now being developed by the National Lumber Manufacturers' Association, the superiority of the timber column for slow-burning construction will be assured. With the commonly accepted cap details now in use, the unprotected timber column is rated 2½ times superior to unprotected steel. The fire resistance of heavy timber construction is constantly demonstrated in practice. On April 9, 1921, fire occurred in the lumber dry-kilns of the Camp Mfg. Co., at Wallace, N. C. Seven of the kilns at this plant were covered with a 6-in. laminated wood roof, and two kilns with an arched hollow-tile roof. The laminated roofs burned very slowly and assisted in keeping the fire within the kilns. The arched tile roofs collapsed in from one to two hours.

Compressive strength tests on specimens of the timber cut from the tested columns compared to similar specimens of unburnt timber show no loss in unit strength of the material after it has cooled off. GEO. E. STREHAN,

New York City, Aug. 8. Consulting Engineer.

Simplified Methods of Plotting Traverses

Sir—The old adage, "There is nothing new under the sun," is peculiarly applicable to the article in *Engineering News-Record*, July 28, 1921, p. 160, entitled "Simplied Method of Plotting Transit and Stadia Traverses," by Herbert N. Bradstreet. In the bygone days of railroad building this system was in universal vogue, and I have plotted many hundreds of miles of surveys by a slightly better modification, which consisted in fastening a large paper protractor on the sheets of drawing paper and pricking off with pencil points in opposite sides the calculated courses of the survey, and then by means of a large parallel ruler transferring their courses, instead of using large triangles and the rather slower method of laying off deflections from a transferred meridian. It seems to me that the once familiar parallel ruler has become obsolete.

I have also used sheets on which the protractor was printed in a light color, yellow or green, which did not obscure the mapping work.

Buffalo, N. Y., Aug. 2. EMILE LOW.

HINTS FOR THE CONTRACTOR

Grouting Sewer Tunnel Cavity from Test Pits Avoids Building Settlement

BY LEO G. HALL
Onekama, Michigan

DURING the preliminary grading for the large factory of the Willys Corporation at Elizabeth, N. J., the surface of the ground in one place dropped in, leaving a hole about 15 ft. in diameter and 10 ft. deep. The hole was directly under one of the principal buildings, a four-story concrete structure whose piers were designed for a load of 200 tons each.

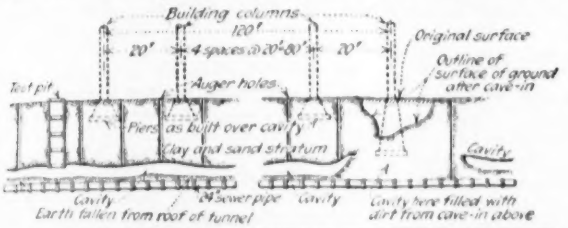


FIG. 1. LONGITUDINAL SECTION OF SEWER SHOWING CAVITY, AUGER HOLES, BUILDING COLUMNS, ETC.

Investigation disclosed that a 24-in. sewer had been laid there about 20 ft. underground in a former street some 40 years previously, and that it had been laid in a poorly backfilled tunnel. The tunnel timbers had rotted out, and the vibration of the shovel operations together with heavy rains caused the top to cave in. A test pit which was sunk to the level of the old sewer disclosed this rotted timber work, and an irregular cavity lying along the length of the sewer averaging 3 ft. x 5 ft. in section. The tunnel itself was in a gravel stratum immediately under a clay stratum; and the gravel had fallen away, leaving the clay arch roof.

After some experimenting, it was decided to fill the cavity with a 1:2:4 lime-and-cement-sand grout, mixed very wet. This mixture was found to run a great distance horizontally along the cavity without settling.

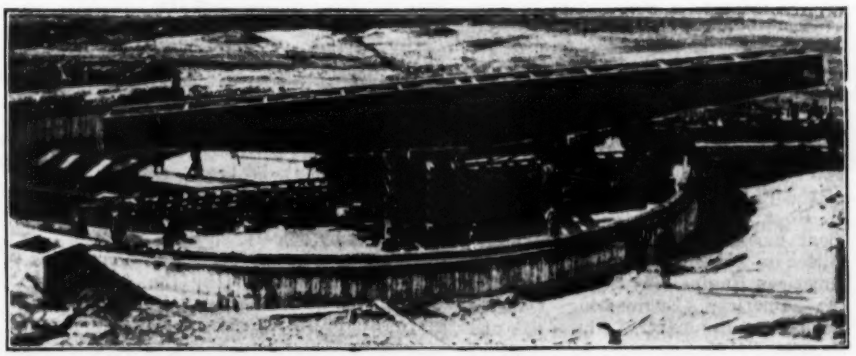
We were able to fill about 20 ft. of the cavity from the test pit. We then secured some 8-in. post-hole augers, fitted them with extensible pipe shanks, and tapped the cavity with them at intervals of 10 ft. We then poured into each hole, successively, as much grout as they would hold. During pouring grout could be seen with the aid of a flashlight, flowing under holes 20 ft. away from where pouring was taking place.

When the pouring was finished a couple of men were kept busy for several days boring holes in the vicinity, to determine whether the grout had penetrated all of the cavity. The grout was found to have stopped up completely every crevice to a distance of several feet from the sewer. A tunnel subsequently dug just outside the building showed that the grout had also compacted the loose fallen earth, and a trip made by the writer into the old sewer showed that it had stopped up several leaky joints.

Placing a 100-Ft. Turntable by Cribbing and Jacks: M., K. & T. Ry.

IN PLACING the 100-ft. turntable for the new engine terminal of the Missouri, Kansas & Texas Ry. at Oklahoma City, Okla., jacks, cribbing and a wrecking crane were employed. The turntable as shipped complete, but without end trucks or center bearing, weighed about 67 tons and was mounted on three flat cars, the ends being supported by blocking on the two outer cars.

The concrete pit, about 8 ft. deep and having a lightly reinforced floor, had been completed about ten days before the girders were placed, 3 x 10-in. timbers being laid along the floor for a width of 18 ft. as a support for the cribbing of an incline track and to distribute the load over a wide area. When the track was ready the front car was removed and the car on which the turntable rested was pushed into the pit by a locomotive attached to the rear car. When the turntable had been spotted into position, cribbing was built up on each side of the car to carry jacks under timbers extending across the bottom of the turntable girders. By a slight lift of the jacks the table was raised clear of the car, which was then removed, leaving the table supported in an inclined position on the center crib



TURNTABLE PLACED IN PIT BY CRIBBING AND JACKS—UNLOADED FROM CAR

At the low end of the table, blocking was then built on the bench for the circle rail, and by raising the high end slightly with a wrecking crane it was possible to remove the center cribbing and lower the turntable to a horizontal position. In this position it rested upon two cribs on the floor, ready to have the end trucks and center bearing placed, the final adjustment being by jacks on the cribbing.

This work was in charge of R. M. Stubbs, bridge engineer. The design and construction of the new terminal are under the direction of F. Ringer, chief engineer of the Missouri, Kansas & Texas Ry.

NEWS OF THE WEEK

New York, August 18, 1921

Bill to Commission Engineers in Public Health Service

Engineering Bodies Endorse Measure—Would Attract Able Sanitary Engineers to Public Service

A bill providing that the sanitary engineers of the United States Public Health Service shall be commissioned in the regular corps of the Service by the President, the same as the medical officers in the Service, and that the sanitary engineers will have equivalent rank, pay, allowances and status as commissioned medical officers of the Service, has been introduced in the House of Representatives and referred to the Committee on Interstate and Foreign Commerce, of which Samuel E. Winslow, of Massachusetts, is chairman. Under the terms of the bill, no commission to sanitary engineers would be granted until after they had passed "a satisfactory examination in the several branches of sanitary engineering and public sanitation before a board of commissioned officers of the said Service." Similar examinations are required of candidates for commissions in the medical branches of the Public Health Service.

The movement for securing legislation of the kind proposed has received considerable support from engineers and others. A committee to consider the subject has been appointed by George S. Webster, president, American Society of Civil Engineers. This committee has as chairman George G. Anderson, Los Angeles, Cal., and as its two other members Prof. A. N. Talbot, of the University of Illinois, and John C. Hoyt, of Washington. The movement has been endorsed by the Committee on Public Affairs of the Federal American Engineering Societies and by the American Engineering Council. Efforts on the part of the American Association of Engineers in behalf of the bill are in charge of A. T. Koehler, manager, Federal Department, A. A. E., Washington, D. C. The Surgeon-General of the American Public Health Service has expressed himself in favor of the bill. Ewing Laport, assistant secretary of the Treasury (of which the Public Health Service is a bureau), has stated in a letter to E. G. Sheibley, Los Angeles, that the Treasury Department "fully appreciates the great value of the service performed by sanitary engineers in public health work" and that legislation making it possible to commission sanitary engineers in the Public Health Service "on the same status as medical officers would benefit public health work and attract competent sanitary engineers who wish to make a public health career their life work."

Campaign Begun in California for State Development of Power

An initiative campaign just launched in California has as its object the placing on the ballot at the election in November, 1922, of an amendment to the state constitution providing for the development and distribution of hydro-electric energy, under a state agency for the benefit of cities, irrigation and reclamation districts or other community organizations. This result would be accomplished by the creation of a water and power board, consisting of five members, with power to contract for the construction and operation of hydro-electric systems. The board would issue and sell bonds to the extent of the funds required, the state lending its credit in such issues to a limit of $500,000,000. Four of the board members would be appointed by the governor and the director of the newly-created state department of public works would serve as the fifth member.

The League of California Municipalities has taken a prominent part in launching the new plan. Individuals mentioned as having part in drafting the proposed amendment are Clyde Seavy, City Manager of Sacramento; Louis Bartlett, Mayor of Berkeley; W. B. Mathews, attorney for the Los Angeles board of public works; Dr. Horace Porter, Mayor of Riverside; Rudolph Spreckels, of San Francisco and William Kent, ex-Congressman from California.

To Encourage Military Invention

Announcement is made that it is the policy of the War Department to encourage the development of military inventions by officers, enlisted men and civil employees. In consideration of assistance to be given by the department in the issue of patents, it will require of inventors no more than a license to manufacture and use their inventions for government purposes, thereby reserving to the patentee complete freedom and ownership of the patent in commercial application. In special cases of inventions of great military importance, however, provision is made for exclusive government ownership and the utmost secrecy.

Zone Commission for Chicago

Under an ordinance passed about a year ago the mayor of Chicago has recently appointed a zoning commission, with Charles Bostrum, building commissioner, as chairman. Most of the twenty members are aldermen or city officials; the others include C. P. Wacker, chairman of the Chicago Plan Commission; Wm. Artingstall and Charles B. Duke, civil engineers, and E. R. Graham, architect.

Fatal Concrete Roof Failure In Atlantic City Hotel

Two Panels Fall After 15 Years' Service — Inspector Blames Defect in Concrete

The fall of a section of reinforced-concrete slab roof over the kitchen of the Marlborough-Blenheim Hotel in Atlantic City on August 9 caused the death of a waitress and the injury of several other persons. The collapse, which occurred just after 1 p.m., involved two panels of roof along one of the exterior walls, an area about 15 x 33 ft., and occurred in a kitchen annex separate from but connected with the main hotel building. Much of the wall in front of the two panels fell with the slab. The structure had been standing for 15 years, having been built in 1906. No official explanation of the cause has been made up to the present time. The roof was a cinder-concrete slab 8 in. thick, reinforced with wire mesh, carried on concrete beams supported by cast-iron columns 16 ft. 8 in. on centers both ways. The walls here were brick with the slab supported directly on them.

Theories as to Failure

Building Inspector Peterson of Atlantic City in an interview directly after the failure suggested that a bubble in the concrete was responsible for the failure. Reporting to the mayor on the following day he stated that the slab had insufficient reinforcement and also said: "This slab had a fracture alongside the structural girder and within an inch and a half of the under side which shows that the water had been getting through it for some time and caused it to rot. As there was no reinforcement there was nothing to hold slab up and in my opinion the construction of the entire roof is poor."

J. J. White, president of the hotel company, stated after the collapse: "As far as we can determine a portion of the west wall of our separate two-story kitchen building about 25 ft. long and extending about 12 ft. to the ceiling or roof, buckled out and fell into the outside courtyard. One section of concrete roof about 15 ft. wide and of like length, which rested upon the wall, fell to the kitchen floor. We have not as yet been able to ascertain the cause."

Later Mr. White made the following statement to *Engineering News-Record:* "We are unable to tell at the present time whether it was the slab or the wall which failed. If the latter it was probably due at least partially to the defective workmanship in the placing of the wire mesh reinforcement in this particular roof slab so that it was almost on the under surface of the slab instead of being an inch above the under surface as it should have been."

Investigation of the collapse made for *Engineering News-Record* by Lewis R. Ferguson, of Wig, Hollister & Ferguson, Philadelphia, indicates that some of the wires of the reinforcing mesh corroded because of access of moisture and others were ruptured through excessive tension, presumably after the failure of the corroded wires through additional load on them. Mr. Ferguson's report is given on page 271 of this issue.

The Marlborough-Blenheim was the first large reinforced-concrete building on the sea coast, and aroused wide interest at the time of its construction in 1905-6.

The building was described in *Engineering Record* of Dec. 23 and 30, 1905, pp. 719 and 743, and in *Engineering News* of Mar. 8, 1906, p. 251.

Williams Not a Candidate for Highway Commission

In *Engineering News-Record* of June 30 a news item stated that S. M. Williams, chairman of the Federal Highway Council, was being talked of as a probable candidate for the Federal Highway Commission, proposed in the highway bill now before the Senate. The item having come to the attention of Mr. Williams, he has disclaimed any desire to be a candidate. He says in a letter under date of Aug. 12:

"May I say definitely that I am not a candidate nor could I conscientiously consider the appointment if tendered, because I could not afford to accept a position, having assisted in the promotion of legislation for its creation. Unfortunately, we have too many examples where efforts for legislation have been prompted by desire for the job and I do not want to be included in that class.

"My effort for the creation of a Federal Highway Commission has been with the same motive which always prompted my contributing much time and effort for the past ten years, in the development of highways and transportation, namely the public need.

"I sincerely believe that three capable men can and should be found who have had no direct participation in promoting the legislation for the creation of the Commission if it is authorized by Congress, and to those men I will pledge my loyal coöperation."

Wood Preservers Will Establish Service Bureau

For the purpose of furnishing information concerning the uses of treated timber, the American Wood Preservers' Association is establishing a service bureau at 10 S. La Salle St., Chicago. P. R. Hicks, engineer, Forest Products Laboratory, Madison, Wis., has been appointed secretary-manager. The bureau will be prepared to answer inquiries regarding the use of treated and untreated timber and various methods of treatment.

Revised Townsend Highway Bill Goes to Senate

The Townsend highway bill, revised so as to make possible a unanimous report from the Committee on Post-offices and Post Roads, was presented formally to the Senate on Aug. 15, with the urgent recommendation from the committee that it be passed promptly. It was Senator Townsend's intention to move to take up the bill on Aug. 16 or Aug. 17. He expresses the hope that the Senate will pass the measure so as to allow the conferees of the two houses to adjust the differences between the Townsend bill and the bill passed by the House. An effort will be made to reach an agreement and secure the approval of the conference report prior to the congressional recess.

The Townsend bill, as reported, provides for a federal highway commission to be composed of three members. The state highway departments are to be allowed an important part in the administration of the act but federal aid is to be limited to 7 per cent of the total rural highway mileage in each state. Three-sevenths of this mileage must be composed of interstate highways while all of the remaining mileage must consist of roads which connect with interstate highways.

The states are required to maintain all highways in proper condition.

The bill carries an appropriation of $100,000,000 for the current fiscal year. Half of that amount is to be available immediately and half six months after the passage of the act.

Surplus Road Equipment Charges Unfounded, Says MacDonald

Washington Correspondence

Ever since the federal government has been distributing surplus equipment to the states for use in highway construction there have been frequent allegations that this property was being disposed of illegally by some of the state highway commissions. On several occasions investigations have been made by the U. S. Bureau of Public Roads. In each case the reports have been proved erroneous. With the possible exception of irregularities in connection with the Arkansas muddle, Thomas H. MacDonald, chief of the bureau, is positive that no state highway department has disposed of federal equipment so long as it was serviceable for highway work.

Mr. MacDonald calls attention to the fact that more than $100,000,000 worth of surplus property has been distributed among the states through his bureau. In this way, he declares, the public has been able to get the maximum return on its investment in this material. In quarters other than the Bureau of Public Roads, it is believed that these sporadic charges against the state highway commissions have had their origin with those having selfish interests in the sale of government surplus property.

Street Cleaning Officials Meet in Chicago

Society Well Launched Changes Name—Whole Two-Day Program Consists of Round Table Talks

Methods of street cleaning and the disposal of refuse were the main topics discussed Aug. 10 and 11 in Chicago at the second annual conference of the International Association of Street Cleaning Officials. The organization now has a membership of 85, of which 61 are active members—officials—and 24 are associates. Most of the large cities are represented. The membership is distributed over 27 American states and three Canadian provinces. At the opening session 45 were in attendance. Unlike most programs, no papers were scheduled, but the officers had arranged six subjects for discussion, which took the form mainly of recitations of experiences in the home town of the official speaking.

Three amendments to the constitution were made: 1. The name was changed to International Association of Street Sanitation Officials to make the organization more comprehensive. 2. Three vice-presidents instead of one are now included in the list of officers. 3. Associate membership is extended to engineers and publishers.

Garbage Disposal

The disposal methods described referred mainly to incinerators. Abram Swan, engineer of streets, Trenton, N. J., detailed the successful burning of 70 tons daily of garbage in the summer and 30 tons in the winter. In two years 225 tons of coal have been used. Despite the large foreign element householders have been educated to drain and wrap all garbage. The collection cost is $2.35 per ton and incineration 33c. Common workmen receive $30 per week and drivers $31. Adolph P. Schuck, Baltimore, spoke of the failure, after 16 months' operation, of a hog-feeding company which spent $60,000 for equipping a 127-acre farm rented from the city. Unknown causes killed 15 to 50 pigs per day. At present the garbage is loaded on scows and sold to farmers, but an injunction operative Sept. 1 will compel a change. A committee visited 35 cities but found none satisfied with its present method. The city decided to let the disposal out by contract and recently awarded a 10-year contract to a reduction company for $2.70 per ton.

W. F. Tallman, Winnipeg, said 90 to 95 tons daily were collected. Domestic garbage, wrapped, is collected twice a week and burned without use of any other fuel than rubbish. Incineration costs are 50 to 70c. per ton. Disposal of ashes is a problem because of the flatness of the country. A "mountain" on the prairie 25 ft. high is being built.

P. H. Connolly, city engineer, Racine, Wis., stated that 20 to 30 tons of wrapped garbage is incinerated without complaint in the center of the city at a cost of $1 per ton. Collection costs

$2.48 per ton. East St. Louis gets $1.80 per ton for garbage sold to piggeries. The St. Paul collection system, reported by H. C. Wenzel, consists of 50 farmers' routes and 30 municipal routes. The cost is $44,000 for 80,000 tons. It is planned to save $10,000 yearly by motorizing the system. E. F. Murphy, Boston, said bids for a 10-year contract for the disposal of garbage, ashes and rubbish, would be opened Sept. 1.

Much discussion was given to flushers, the double-unit type apparently being in most favor. Although admitting the damage done to pavements, particularly apshalt, the consensus of opinion was that the results justified flushing. It was considered the best means of handling fine dust. No one spoke of vacuum systems. W. J. Galligan stated that the use of power flushers was started in Chicago two or three years ago. He expects to add five to eight each year until the department has fifty. He is of the opinion that the danger to pavements is small if the stream is properly directed.

Snow removal received some attention. Motion pictures of two new devices were shown, a snow loader and a rotary broom sweeper suspended from a motor truck and operated by a power plant carried on the truck.

The officers elected for the ensuing year are as follows: President, W. J. Galligan; vice-presidents, Abram Swan, E. F. Murphy and J. S. Miller; secretary, A. M. Anderson, Old Colony Building, Chicago; treasurer, R. W. Waddell.

Tentative Valuations Issued

Additional tentative valuations covering the properties of twenty-three companies have been issued by the Interstate Commerce Commission. They include the St. Louis Southwestern, the Green Bay & Western, and the Wichita Union Terminal Co. All include single sums as "final value" and a statement of the present cost of condemnation and damages of acquiring lands in excess of "present values." A comparison with other quantities of sums given as final value is indicated for ten of the properties in the accompanying table.

TENTATIVE VALUATIONS ISSUED BY INTERSTATE COMMERCE COMMISSION

Name of Road	Final Value*	Cost of Reproduction (New)	Cost of Reproduction (Less Depreciation)	Investment in Road and Equipment	Capitalization
St. Louis & Southwestern. . . .	$26,716,924	$18,424,505	$14,588,819	$67,430,327	$16,356,100
Gray's Point Terminal R.R.	1,321,000	1,269,676	1,040,280	1,844,653	500,000
Paragould Southeastern	424,000	526,000	365,623	518,148	100,000
Central Ark. & Eastern	600,000	681,281	518,003	1,070,139	150,000
Green Bay & Western	5,298,582	5,203,425	4,098,052	10,279,343	10,100,000
Kewaunee, Green Bay	1,289,193	1,005,960	809,368	1,279,512	664,950
Ahnapee & Western	676,408	679,299	552,114	978,437	439,500
Montpelier & Wells River	1,750,000	1,937,229	1,513,484	1,163,610	894,800
Wichita Union Terminal	2,070,911	1,180,745	1,144,353	1,999,827	100,000
Dallas Terminal Ry	1,187,810	384,874	305,233	946,979	10,000

* Wholly owned and used.

Original cost of lands of the St. Louis Southwestern wholly owned by the carrier and devoted partly to carrier and partly to non-carrier purposes is found to be $1,374,440. The present cost of condemnation and damages in excess of "present value" of lands owned is reported as $1,713,252.

Ontario Commission Against Hydro-Electric Line

An adverse report on the project for constructing and operating a number of electric railways by the Ontario Hydro-electric Commission, through an issue of bonds guaranteed by the government, has been made by the commission appointed by the provincial government to investigate the matter. Decision against the construction of additional lines and development of the "radial" system is based on the present financial situation in the electric railroad industry generally, possible competition with the Canadian National Railways by paralleling lines and the desirability of testing the effect of highway development before undertaking electric line building.

It was generally anticipated that the majority report would oppose the plan. The reasons cited are as follows:

The financial condition of electric railways in Ontario and the United States has been precarious and unsatisfactory and the outlook discouraging; the evidence submitted indicates that the proposed electric railways would not be self-supporting. Their construction paralleling and competing with the Canadian National Railways system would be economically unsound, and a serious blow to the success of government ownership. Until the Chippawa power scheme, estimated to cost $60,000,000 or upward, is completed and shown to be self-supporting, the government would not be justified in endorsing the construction of an electric railway system at an initial estimated cost of $45,000,000. The endorsement of bonds by the province for systems of electric railways at the instance of the municipalities concerned is held highly dangerous and likely to lead the province into great financial difficulties, as it would give rise to demands for like accommodation from other localities which it would be hard to refuse. The expenditure of $25,000,000 on public highways in the province having been begun, it would be unwise to commence the construction of electric railways until the effect of highway improvement has been ascertained and the use of them by motor cars and trucks made clearly apparent. The rapidly increasing debts and financial commitments of the Dominion, Province and municipalities have aroused well-founded apprehension, and are a cogent reason against the embarkation in the construction of the contemplated electric railways.

The report is signed by four of five members of the commission: Judge Sutherland, the chairman; General C. H. Mitchell, W. A. Amos and A. F. Macallum, C. E. The minority report by Frederick Bancroft, labor representative, controverts most of the conclusions arrived at in the majority report, recommending that the government should adopt the principle of publicly owned and operated electric railways. He states that unemployment conditions would be considerably relieved through the hydro-radial development.

Refuses Roads Maintenance Costs for "Labor Inefficiency"

In a decision made public Aug. 6, 1921, the Interstate Commerce Commission refused to include allowances to the railroads, in maintenance accounts for the six months' guarantee period, for "labor inefficiency" or the decrease in the effectiveness of railroad labor due to the National Agreements and other causes. Three commissioners dissented from the opinion, one not participating.

The controversy has hinged on the construction to be placed on the term "cost of labor." The Transportation Act, in providing for the six months' guarantee of earnings, limits the amounts to be charged in operating expenses for maintenance accounts, to sums to be fixed by the commission, with due regard to usage and differences in "the cost of labor and materials" as in comparison to the three-year test period previous to federal control.

The railroads contended that cost of labor is the cost of performing work and should not be construed as price of labor as reflected by wage scales, claiming that the National Agreements had resulted in a decrease in the effectiveness of labor irrespective of wage rates. The commission held such allowances to be inadmissible largely through lack of proper determination.

Crown of Full Gas Holder Ruptured by Unknown Cause

A 3,000,000-cu.ft. gas holder of the Consolidated Gas Co., New York, located at 15th St. and Ave. C, failed in a remarkable manner on Aug. 12, while in normal service. The holder was nearly full at the time. A rupture developed suddenly at the junction between the crown and the shell of the upper section, opening a large hole through which gas was forced out. The gas fortunately did not become ignited, and the holder sank as the contained gas escaped, aided by pumping to transfer gas from the ruptured holder to others nearby, until fully down in its tank. The steel tank is unaffected, and so far as known none of the lower holder sections are damaged.

Pending the pumping out of the tank to permit full examination of the break the nature of the accident remains unknown. The top course of the upper holder section, a curb course of plate about ⅜ in. thick, is broken through on a vertical line and thrown or rolled back. The thin crown plating is ripped and crumpled fifteen or twenty feet back, apparently by a force at the curb. The shell course below the curb is also damaged, but the extent of this damage is less definitely known.

The holder has been in service 30 years. It was built by the Continental Iron Works. Recently it was painted, and with regard to drying of the paint on the lower sections it was kept nearly full. More definite facts concerning the rupture are expected to be available after the damaged parts have been exposed and examined.

William C. Robinson

William Colin Robinson, vice-president and chief engineer of the Underwriters' Laboratories, died on July 31 from an acute attack of illness after a notable career of nearly 30 years in the development of fire protection by the aid of testing. He was only 53 years old at the time of his death, but had spent his entire professional life in the service of fire protection, and had attained a position of countrywide authority in many phases of the art.

Testing of materials affecting fire hazard was begun by W. H. Merrill and Mr. Robinson about 1893, in connection with the Chicago Board of Fire Underwriters, and two years later this work was organized in the form of the Underwriters' Laboratories, an institution with which both men have remained continuously associated since that time. Electrical testing was among the first lines of work carried on, and the importance of this investigative and test work is generally known. However, the scope of the Laboratories' research and test work grew in the course of a few years to cover a remarkably wide range.

Of the earlier work with which Mr. Robinson was intimately connected the development of standards and methods of test for fire doors, wire glass and metal-frame windows and fire extinguishers was prominent. Mr. Robinson was a leading authority in these fields and in all matters relating to sprinkler equipment. Later work dealt with a great variety of building materials and construction systems, including brick and tile, wall boards, roofing, and floor and partition constructions. The investigation of fire protection of building columns, recently completed, was one of the most elaborate of these researches, and here Mr. Robinson's ability in planning pre-test equipment was of determining influence. Investigations of large scope yet uncompleted at the time of his death related to cast-iron pipe, to safes, to roofing, to pressed steel construction and other subjects.

Mr. Robinson was distinguished for high ingenuity in devising and applying testing methods and apparatus to the particular service in which he was engaged. He is largely responsible for establishing the view that fire-protection testing must be done in full size, to bring out the true conditions arising in severe building fires. He improved the testing of partitions and similar structures by introducing restraint by a surrounding frame or its equivalent. He contributed materially to the introduction of the standard time-temperature curve for fire tests. Shortly before his death, he took the initiative in a step of fundamental importance, namely the study of time of fire exposure for different kinds of occupancy, a study which, when completed, will for the first time place fire-resistive construction on a plane of sound engineering design.

He was distinguished also for his care and caution in interpreting test results, being notably reluctant to issue reports on investigations made until their conclusions were incontrovertibly grounded, and correspondingly dependable in his opinions. His conclusions on fire-protection questions were rarely questioned. Integrity, practical sense and a conscientious objective attitude were characteristic of the man.

Denies Certificate for Cleveland Public Square Station

Issuance of a certificate of public convenience to the four carrier applicants for the construction of a union passenger station at the public square at Cleveland, Ohio, has been denied in a report by Division 4 of the Interstate Commerce Commission in a decision made public August 15. The applications of the New York Central, the Big Four, and the Nickel Plate have been pending since hearings were first initiated last February. A re-hearing was held in Washington August 2 before the Commission as a whole. The applicants had applied for a certificate of public convenience and necessity to permit the construction of a new passenger terminal at the public square through contract with the Cleveland Union Terminals Co. The applications were strenuously opposed by Peter Witt, former transit commissioner of Cleveland under the Johnson administration, who appeared in all of the hearings before the commission.

The majority opinion of the commission holds that the Cleveland terminal problem has received inadequate consideration and that the commission is "not persuaded by the evidence now before it" that the plan is compatible with public interest or that sanction should be given to the enormous expenditure of capital which the plan involves. "Possibly the presentation of further evidence or the modification of the plan in various particulars," says the opinion, "might make possible a different conclusion." It is stated that dismissal of application need not involve delay in terminal improvement at Cleveland since the railroads feel that as now situated the consummation of such a large project would not be practicable.

In a dissenting opinion Commissioner Potter of Division 4. states that it is clear that new passenger facilities and relief from existing freight congestion are necessary at Cleveland, stating that the public square plan seems to be justified and preferable to the site on the Mall. "While the expenditure involved in the proposed improvement is large," says Commissioner Potter, "I cannot see that public interest forbids it. . . . It seems to me that the city of Cleveland, the travelling public and shippers who will use the improved facilities are entitled to have the improvement made even though the new investment increases the burden on the public generally." The "strong support" that the public square station project has received in Cleveland is also cited.

Huge Bridge Program in Bond Issue for Pittsburgh

Bridge construction to the amount of about $25,000,000 is provided for in a bond issue to be voted on by Allegheny County (Pittsburgh) on Sept. 20, according to a resolution just passed by the county commissioners. In addition to this sum, about $2,000,000 for the purchase of the three last remaining toll bridges over the Allegheny River will be included in the vote. The entire vote — about $41,000,000 — will include $10,000,000 for roads and $2,000,000 for buildings and other purposes.

Two of the Allegheny River bridges requiring reconstruction in accordance with the order of the War Department for raising and increasing the spans of bridges are provided for in the proposed bond issue: the Fortieth St. bridge, for which plans have been prepared by B. Janssen, architect, with C. S. Davis as engineer, and the Thirtieth St. bridge, which was destroyed by fire a month ago. Funds for construction of the Sixteenth St. bridge were provided by a prior bond issue; this structure was designed by Warren & Wetmore, with H. G. Balcom as engineer. A separate item in the vote provides $3,500,000 for reconstructing 6th, 7th, and 9th St. bridges.

Bridges Proposed

Four very large bridges over the Monongahela and one over the Ohio River are also included. The largest of these are the Liberty Bridge, to connect the north portal of the Liberty Tunnels with the main part of the city ($4,000,000), and the proposed bridge from McKees Rocks to Woods Run ($6,600,000). The full bridge schedule of the bond issue includes the purchase of Monongahela River bridges at Rankin and Glenwood ($1,000,000 and $700,000) and the Neville Island bridge over the back channel of the Ohio ($250,000); the construction of three bridges over the Allegheny, at 30th St., 40th St. and Natrona ($1,500,000, $2,800,000 and $280,000); bridges over the Monongahela at Wilson, Homestead, Riverton and South 3rd. St. ($1,200,000, $2,500,000, $2,000,000 and $4,000,000); a bridge over the Ohio at McKees Rocks ($6,600,000); and bridges over East St. and Jacks Run ($320,000 and $850,000). A separate item of $3,500,000 for the raising of the 6th, 7th and 9th St. bridges brings the total up to $27,500,000.

J. G. Chalfant, county engineer, advises that the costs have in all cases been estimated large enough to permit first-class design for the heaviest type of highway traffic, and, in a number of cases, designs monumental in character. Some of the estimates are based on only preliminary sketches. The figures were computed on the basis of steel erected at 10c. per lb., concrete above foundations, $12 to $15 per yd., and in river foundations, $40; excavation and fill, $2 per yd. for earth and $10 for rock; lumber, $80 per M; wood block pavement, $4 per sq.yd. laid.

Form Transportation Division of Farm Inquiry Commission

Formation of the division of transportation of the Joint Congressional Commission on Agricultural Inquiry was announced Aug. 2. Donald D. Conn, First National-Soo Line Bank Building, Minneapolis, has been appointed in charge of the division. One of the six subjects which the joint commission is to investigate under congressional resolution is "The marketing and transportation facilities of the country." The division of transportation, according to the announcement, will be charged with making a thorough analysis of rate and car service problems as affecting prices of commodities produced and utilized by agriculturists. Sidney Anderson is chairman of the commission.

Reduce Highway Crossing Grades

Under a new law for the protection of grade crossings in Michigan not only are signs to be placed 500 to 600 ft. from each crossing, but the highway for 25 ft. on each side of the tracks must be level or with a grade not exceeding 3 per cent. It is reported that at a meeting of county road commissioners and the public utility commission it was decided to leave the enforcement of the law to the local authorities, but that where they fail to act the commission will undertake the work. About 20 per cent of the crossings are to be improved each year.

Full Municipal Street Cleaning Service at Philadelphia

In furtherance of the plan for complete municipal instead of contract service in street cleaning and in the collection of garbage, rubbish and ashes at Philadelphia, the City Council has passed and Mayor Moore has signed ordinances providing $1,250,000 for the purchase of sites and equipment for the work. Bids for a large incinerator are to be received on Aug. 26, as noted in this section Aug. 11. The city took over the reduction plant some months ago. It has been cleaning the streets in a considerable section of the city since Jan. 1 of this year. On Jan. 1, 1922, it expects to put its entire program of direct city work in this field into effect. Fred C. Dunlap is chief and J. H. Neeson deputy chief of the Bureau of Highways and Frank H. Caven is director of the Department of Public Works.

To Extend Rock Creek Park

Lieut.-Col. C. O. Sherrill, the engineer officer in charge of public buildings and grounds at Washington, has announced the completion of preliminary plans for the extension of Rock Creek park so that it will connect with Potomac park. The lower end of the Rock Creek valley, now particularly unsightly as contrasted with the upper reaches of the stream, is to be improved with a drive near the creek level along with a full complement of walks, bridle paths and shrubbery.

PERSONAL NOTES

CHARLES A. MAY, a former employee of the U. S. Reclamation Service, and for the last two years assistant highway engineer of New Mexico, has been appointed state engineer of New Mexico.

ASA E. PHILLIPS, after more than thirty years' continuous service with the District of Columbia, has resigned, effective Aug. 16, as sanitary engineer. He has served under 12 of the 16 engineer commissioners of the distric. During the early years of his service he was engaged on mapping the drainage system, plans and estimates for new drainage works, rainfall and run-off studies, hydraulic data and experiments. From 1900 to 1908 he was engineer in charge of designs, estimates and construction of the sewage disposal system, and from 1908 to 1921 he was head of the sewerage division, Engineer Department, first as superintendent and later as sanitary engineer, and had charge of the underground construction work of public service corporations.

HERMAN H. SMITH, formerly chief engineer, Bureau of Highways, Borough of Brooklyn, N. Y., was appointed, Aug. 2, deputy chief engineer of the New York Board of Estimate and Apportionment in accordance with the recommendation of Arthur S. Tuttle, chief engineer of the board. Mr. Smith was a graduate of the Massachusetts Institute of Technology, class of 1899, and after serving four years in the engineering department of the Long Island R.R., joined the staff of the Brooklyn highway bureau as engineering assistant in 1903. He was subsequently promoted in 1907 to become assistant engineer in charge of maintenance and four years later became chief engineer of the bureau.

F. C. FINKLE, consulting engineer, Los Angeles, Cal., has been selected as consulting engineer for the Fruitvale Mutual Water Co. of San Jacinto, Cal., organized during the last few months and which has acquired the irrigation system of the Citizens Water Co., which formerly, as a public utility, served over 3,000 acres. The Fruitvale Mutual Water Co. is planning to serve 5,000 additional acres.

W. S. RICHMOND, formerly employed by the Larner-Johnson Valve & Engineering Co., Philadelphia, Pa., and for about a year in private consulting engineering practice in Detroit, Mich., in connection with hydro-electric power plants and general hydraulic problems, has moved to Buffalo, N. Y., where he will continue in engineering practice.

W. G. BLACK, of Black & Griffin, consulting engineers, Mandan, N. D., has been elected a member of the Park Commission of Mandan for a term of five years.

FREDERICK R. MILLER, civil engineer, has been appointed a member of the Ontario Hydro-Electric Power Commission to succeed Hon. J. B. Lucas, who will retire. Mr. Miller was in charge of the Imperial Munitions Board plant at Toronto, Ont., during the World War and is vice-president of Roger Miller & Sons, Toronto, formerly munitions manufacturers and at present engaged in harbor improvement works for the Canadian government.

C. F. CONVERT, formerly assistant bridge engineer of the North Dakota Highway Commission, has entered the employ of Black & Griffin, consulting engineers, Mandan, N. D.

A. L. FERVER, superintendent of the plant department, Southwestern Shipbuilding Co., has been appointed Director of public service and ex-officio city engineer of Long Beach, Cal.

B. B. BORTNER has recently entered into partnership with C. Ross Lindemuth, consulting and practical civil engineer, Fort Wayne, Ind.

MURRAY SULLIVAN, formerly acting chief engineer of the Chuchow-Chinchow Line and the Chouchiakou-Hsiangyang Line, Chinese Government Rys., is now general manager of the Chinese Engineering & Development Co., with headquarters at Peking.

OBITUARY

C. E. POWELL, general inspector of bridges, Chesapeake & Ohio Ry., died July 26 in Covington, Ky. He was 45 years old and had been connected with the above railroad for about 20 years.

SAMUEL A. FORTNER, construction engineer, died August 3 in Springdale, Pa. He was born in Marysville, Kan., and was graduated, with the degree of B.S. in Civil Engineering, from the University of Kansas in 1908. In 1908 he became assistant division engineer in charge of construction of the west half of North Gooding Tract of Idaho Irrigation Co.'s project north of Gooding, Idaho. He also was resident engineer and late construction engineer on the Willow River Land & Irrigation Co.'s Dam No. 3, near Brogan, Ore. During the World War he directed the construction of naval buildings along the coast in France. At the time of his death he was in Springdale, Pa., supervising the erection of an electrical plant.

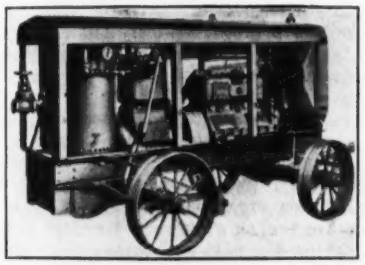
JOHN L. COCHRANE, statistician for many years of the United States Bureau of Mines, died in Cleveland, Aug. 3. Mr. Cochrane's death came suddenly following his gradual recuperation from a paralytic stroke which occurred in January. The deceased had been in the federal service in Washington for 14 years, first with the Technologic Branch of the United States Geological Survey, and later with the

Bureau of Mines. In the protracted effort to obtain Congressional enactment for the establishment of the Bureau of Mines, Mr. Cochrane rendered great assistance to the late Dr. Joseph A. Holmes, who was made the first Director of the bureau. Since the creation of the Bureau in 1910, he had been in charge of the publication work of the organization, and, through the dissemination of safety information and literature, had played an important role in the work of the Bureau in reducing death and accident rate in the mining industry. Mr. Cochrane was co-author of a bulletin of the United States Geological Survey on "The Fire Tax and Waste of Structural Materials in the United States." He contributed to the technical press a large number of articles on mine-safety and mineral conservation on topics. Before entering the federal service Mr. Cochrane had been engaged in newspaper work in various cities oin Ohio. He occupied editorial positions on the Cleveland *Leader* and the Cincinnati *Commercial-Tribune*, and was for a time city editor of the Washington *Post*. Mr. Cochrane was born in Dundee, Scotland, 49 years ago. He came to the United States when eight years old.

NEW EQUIPMENT

Portable Air Compressor

In designing its new class P2-DGL type of gasoline-driven portable air compressors, the Chicago Pneumatic Tool Co. endeavored to secure a lightweight outfit of large capacity. The



compressor has a capacity of 128 cu.ft. of air per minute, at a pressure of 100 lb. per sq.in. The weight of the outfit complete is 4,500 lb.

The compressor is of the two-cylinder, single-acting, vertical type, with the cylinders cast en bloc and entirely water-jacketed. The engine is of the tractor-marine, four-cycle, four-cylinder type. The compressor and engine shafts are connected by a flexible coupling which also serves as a flywheel.

A pneumatic throttle working automatically with the engine governor and the differential unloader of the compressor throttles down the speed of the engine when the compressor is running unloaded, thus effecting economies in the use of fuel and lubricant.

The unit is provided with a removable steel cover which may be locked in place.

Skimmer Scoop Attachment

The Skimmer Scoop has been designed for tearing up old roads, grading new roads, and for other types of shallow excavation. It is built by the Pawling & Harnischfeger Co., of Milwaukee, for attachment to either its No. 205 or No. 206 excavator crane.

The scoop loads by being run out from the machine. When the bucket is filled the boom is raised, swung over the wagon and the load released. The under side of the bucket is hinged at the forward end and is released, for dumping, by a line from the cab.

The boom is interchangeable with the standard boom for this type of crane, and the new device can be installed within a few hours. The shovel attachment, brought out by the company earlier in the year, is likewise interchangeable, so that at relatively small additional investment the contractor may have a steam shovel, a skimmer scoop, or a standard crane, the latter with all of the flexibility of that type of equipment.

In a recent contract on Hawley Road, near Milwaukee, William Datka, the contractor, made a comparison between the cost of grading with the use of a Skimmer Scoop as against plows and wheelers. His figures showed a saving of $83.44 per day by use of the machine.

Truckmixer for Road Work

A mixer mounted on a motor truck and operated by power from the truck engine is illustrated by the accompanying cut. In this outfit the ordinary

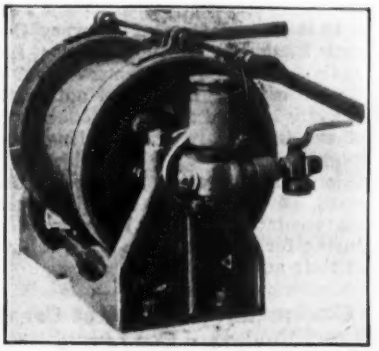
truck body, with its hoist, is replaced with a specially constructed frame which fastens onto the chassis and supports a rotably mounted concrete mixing drum. The power formerly used to operate the hoist is transferred to the drum, making a direct and efficient drive.

The entire mixer, with its mechanism, has fewer parts than the ordinary dump body and hydraulic hoist. Stone, sand and water are put into the drum direct from bins, and the required amount of cement is added at the cement shed or car. Mixing is preferably done on the final stretch, just before discharging, but the drum can also be rotated at the beginning of a haul, and then given a final re-mix action when in place to discharge. When it arrives at the place of laying the concrete, the truck is turned and backed up and the mixed batch is discharged by gravity into a chute which delivers the material to the rear of the truck, and as it moves forward, the chute spreads the concrete.

A fleet of these trucks is to be tried out on a Wisconsin concrete road contract recently awarded. The device is manufactured by The Truckmixer Co., Milwaukee, Wis.

Compact Air Hoist

The Turbinair Hoist, built by the Sullivan Machinery Co., Chicago, is a compact portable air-driven hoisting engine which may be set on a base or mounted



on a column and used for handling drill steel, structural steel, timbers, etc., or for pulling cars, piling lumber, or any odd jobs of hoisting and hauling. It weighs 285 lb. and the drum will carry 500 ft. of $\frac{5}{16}$-in. wire rope. Its capacity is 2,000 lb. lifted vertically at a speed of 110 ft. per minute under 75-air pressure.

The machine consists essentially of a cylindrical drum, mounted on a steel frame and completely inclosing the operating mechanism. The motor has two cylindrical rotors, provided with right- and left-hand helical flutes or vanes converging to a spur tooth in the center.

These two rotors mesh together as they revolve under the influence of the incoming air. The air is admitted at the axis of the drum through a hollow shaft and the motor revolves with the drum. The engine develops a high starting torque and is economical of power.

The hoist is provided with a friction clutch and brake. When both are released the rope may be pulled freely from the drum. The friction clutch may be locked in position and the load raised or lowered, controlled entirely by the throttle valve.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Federal Report on Alleged Price Fixing Association Due Soon

According to advices from Washington the reports of the staffs in the Department of Justice and the Department of Commerce engaged on investigation of alleged price-fixing combinations are soon to be ready. Following the submission of these reports, a definite outline of policy toward price-fixing associations will be announced. Several conferences on the matter have been held by the two cabinet members. It is the statement of Attorney General Daugherty that no interference with legitimate activities will be made, that a great many business associations are of great benefit to the nation, the majority not only desiring to do the right thing, but actually operating in a perfectly legal way. Some are under the ban and some in the guise of trade associations are contravening the law, says Attorney General Daugherty, and are fixing prices in an illegitimate fashion.

It is the assertion of Attorney General Daugherty that the action filed against the so-called cement trust in New York City by federal authorities recently has had a salutary effect upon other industrial organizations who might possibly become the subject of a federal investigation. He says that many of these associations have sent representatives to the Department of Justice for conferences as to the validity of their activities.

Cincinnati Voters Defeat Canal Boulevard Bond Issue

By a vote of almost 2 to 1, the voters of Cincinnati recently defeated a bond issue calling for the authorization of $4,500,000 in bonds for the construction of a boulevard above the rapid transit loop on the site of the old Miami and Erie Canal. In all 36,339 votes were cast on the bond issue, 8,609 votes more than were cast for both the Republican and Democratic candidates for mayor, a fact which indicated the liveliness of the canal boulevard proposition. The bond issue was defeated on the ground that the city now carries about all the bonds of this character it is able to, and because a great many municipal improvements are of more pressing character than the canal boulevard.

Injunction Holds Up Road Job

Strenuous objection on the part of farmers in Butler County to the construction of a stretch of 4½ miles of brick road at $70,000 per mile has resulted in an injunction being granted against the three county commissioners and Leon C. Herrick, Ohio highway commissioner, from paving the road from West Middletown to Jacksonburg.

Car Movements

Due principally to the increased demand for grain cars in the Central West, a reduction of 28,991 in the number of freight cars temporarily out of service on July 31, because of the business depression, was shown by reports just received by the car service division of the American Railway Association. On that day, the total was 526,177 compared with 555,168 on July 23.

Of the total, 321,781 were serviceable freight cars in excess of current freight requirements, while the remaining 204,396 were freight cars in need of repairs. On July 23, serviceable cars totaled 350,772. Surplus box cars in good repair at the end of the month numbered 100,207, compared with 119,442 on the earlier date, or a reduction within that period of 19,235 cars. Reports showed 161,723 surplus coal cars in good order, which was a reduction of 6,845 cars in a little more than a week. A reduction of 1,830 was reported in the number of surplus stock cars, bringing the total on July 31 to 14,467.

Lake Cushman Power Project Reported Upon

In a report on the Lake Cushman power project, Superintendent of Light Llewellyn Evans of Tacoma, Wash., stated recently that the city light department has a surplus of about $800,000 in cash and bonds which it can apply toward the development. It will require a utility bond issue of about $4,700,000, exclusive of the $400,000 already issued for the purchase of the site, for the completion of the first unit. Superintendent Evans explained that by damming the canyon of the north fork of the Skokomish, a lake 8 miles long would be formed, giving a continuous flow of 710 sec.ft., capable of generating 75,000 hp. on a 50 per cent load-factor basis, and warranting a 100,000 hp. machinery installation. He expressed the opinion that it will be a year, or more before actual construction is started, and that it will take at least three years to complete the project.

Highway Toll Bridge Over Columbia River Assured

Pledges made by various corporations in Seattle have been sufficient to assure the financing of the construction of the steel highway toll bridge over the Columbia River between Kennewick and Pasco on the Yellowstone trail. Seattle's quota of $40,000 toward the total cost of $400,000, has been nearly all pledged. The proposed bridge will close an important gap in the system of highways throughout the state, and will provide rapid communication between the eastern and western districts of the state.

Time to Build—When Costs Lack Deflated Expense

A. G. C. General Manager Discusses Downward Trend and Deflation — Normal Level Mythical, He Finds

When steel, cement, brick and lumber prices register anywhere between 48 and 20 per cent above 1914 prices, any possible variation between these points will not be so great as to delay necessary construction, is the view of R. C. Marshall, Jr., general manager of the Associated General Contractors of America. Mr. Marshall includes that assertion in a discussion of the general construction situation which will appear in the September issue of the A.G.C. *Bulletin*.

"To a manufacturer who has a promising production program on his hands," asserts Mr. Marshall, "a problem of a 15-point difference in this interval is insignificant. Likewise the prospective builder of a home may, by this limitation, be enabled to build. Unless the prospective builder desires to wait a number of years he can then doubtless proceed with the confidence that no rapid change in prices will depreciate the value of his structure."

Normal Level a Myth

It is Mr. Marshall's assertion that there is no such ideal condition as a normal price level, commonly taken as the level of prices existing in either 1913 or 1914. He asserts that the arbitary choice of a "normal," which was only a point in a slowly but constantly changing trend of prices, has created in the minds of laymen an idea that any price above 100 in the index is unreasonably inflated and conversely that anything below the 100 index is abnormally low. Such conclusions, as shown by the history of wholesale prices, he believes erroneous. They fail to consider the slow upward trend of prices during the past generation which made the era, on the whole, a period of business prosperity. Mr. Marshall finds that for twenty years prior to the World War prices were steadily increasing at about 2½ per cent a year. This increase except for the war, in all probability, would have reached the so-called normal of 1921 and which is now designated as 120 on the scale of indexes. Therefore, he says that "to say that prices must drop to the 1914 level before the normal conditions have arrived is to ignore the rising trend of the preceding twenty years."

By studying price trends before and after the war of 1812 and the Civil War, Mr. Marshall finds that after each there was a downward trend for thirty years. If this situation is any criterion of what is to happen again, he asserts,

there will be slow downward trend similar to that under which our grandfathers worked. Therefore, Mr. Marshall makes the conclusion: "The man who is determined to wait the return of 1914 prices may be obliged to turn his prospects over to another generation."

Mr. Marshall asserts that whether wages "now paid labor in the building trades must be reduced remains to be seen, but it is significant that since 1820 the trend of wages has been steadily upward in spite of the fluctuation in wholesale prices. This means in part that mechanics have been enabled by improved methods and machines to turn out sufficient work to pay their higher wages. In other words, the standard of living of the working class has steadily risen. This is as it should be, and if the building mechanic can increase his production enough to justify his wages, no one will object."

Prospective owners Mr. Marshall finds are not especially concerned with the daily wage of mechanics, but want assurance that such wages in combination with material and management costs will build a structure containing no inflated expense. This assurance, he asserts, the contractors must provide.

Brazil to Provide Water Storage for Semi-Arid States

In connection with plans for the reclamation of its semi-arid states, the Brazilian government has retained Dwight P. Robinson & Co., Inc., engineers and constructors, New York, to supervise a large amount of the construction work involved. Other work has been let to two British firms. The work to be undertaken by the American firm is located in the states of Ceara and Parahyba and will include the construction of five large dams, involving nearly 1,000,000 cu.yd. of concrete, to create storage reservoirs, some of which, it is said, are to be larger than any artificial reservoirs now existing. Two of the dams are to be some 60 ft. in height and the other three from 160 to 200 ft.

In these semi-arid states of Brazil there is an average annual rainfall of about 30 in., practically all of which falls during the rainy season from January to April, followed by a long dry season. The purpose of the water storage works will be to provide against the dry season since the rainfall, properly distributed, is considered sufficient to produce moderate crops.

Dwight P. Robinson & Co. have already sent one detachment of seventeen men to Brazil and about fourteen more are to sail soon. Ira W. McConnell, vice-president of the firm, expects to sail within a short time to remain in Brazil indefinitely. The work is under the direct control of the Inspectoria de Obras Contra as Seccas which is a department of the Ministry of Viacao e Obras Publicas. The inspector general in charge of the work is Dr. Miguel Arrojado Lisboa. Dr. Pires do Rio is the minister of Viacao e Obras Publicas.

West Coast Lumber Production and Movement

For the week ended July 30, 107 mills in western Oregon and western Washington report production at 54,395,454 ft. b.m., which is 29 per cent below normal. New business totaled 53,804,283 ft. b.m., and shipments totaled 68,395,532 ft. b.m.

For delivery by rail, new business included 1,204 cars; rail shipments 1,238 cars. Unshipped balance in the rail trade was 2,770 cars. Local business totaled 4,236,237 ft. b.m.

In the cargo trade, domestic orders totaled 6,987,046 ft. b.m.; export 6,461,000 ft. b.m., and coastwise and intercoastal cargo shipments totaled 21,325,910 ft. b.m. Export shipments were 5,693,385 ft. b.m.

Production of Southern Pine

For the week ended Friday, Aug. 5, 136 mills, members of the Southern Pine Association, reported a total production of 68,510,563 ft. b.m., which represents 75 per cent of the normal production. Shipments were 2 per cent above production for the week and orders 1.5 per cent below production for the week. There was a slight depletion in orders on hand, due to the excess of shipments over orders. The production for the week is the largest average per mill production that has been recorded since the week ended June 10.

Engineering Advertisers Promote Conference Plan

The Engineering Advertisers Association of Chicago, led by Keith J. Evans of the Joseph T. Ryerson Co., has adopted resolutions supporting an industrial advertising conference plan to be held at the Associated Advertising Clubs' Convention in Milwaukee in 1922. The Engineering Advertisers Association of Chicago suggests as a tentative program subjects as follows: Organization and management of industrial advertising departments; direct advertising and its relation to the movement of goods from industry to industry; the use of business papers in advertising industrial products; the general mediums', newspapers', and magazines' practical use for the industrial advertiser; the agency and its service in the industrial field; and other topics. The movement is gaining ground. The Associated Advertising Clubs of the World have no industrial program at the present time, but have agreed to co-operate in every way.

Worcester Unemployed to Engage in Public Works Construction

According to an arrangement recently made at a conference between the mayor of Worcester, Mass., and heads of city departments, 1,000 of the unemployed men in Worcester were placed at work last Monday on municipal improvements. The men are to work in two week shifts of 250 each on the new reservoir and on an extension of the sewage purification plant.

Newark Settles Wage Dispute

Another dispute in the building industry was settled recently when the arbitrator for masons, bricklayers and plasterers, of Newark, N. J., decided that the existing wage of $10 per day was to be paid these trades until Jan. 1, 1922, providing that New York City's wage scale for these trades shall not be lowered before that time. The Newark scale after January 1 has not been decided. The proximity of Newark to New York and the possibilities of building trade labor being pulled away from that city by the latter were reasons given by the arbitrator why no reductions should be made. The arbitrator advocated holding of conferences between employers and employees in September to determine upon the scale and working conditions which would be operative from Jan. 1, 1922.

In Providence, R. I., the electricians' union has sent copies of a new working agreement to the employers asking for a wage of $1 an hour instead of $1.15 under which they are now working to take effect when the present agreement expires September 1. The same working conditions and hours of employment as are in effect now are asked for in the proposed contract. According to press reports the employers have not accepted the agreement but have made counter offers embodying changes in conditions, and wage scales ranging around 82½c. an hour. Employers also suggest conferences with the unions but the unions refuse to discuss anything under the rate named in their agreement.

Building in Representative Cities, 1914-1920

From data collected by the Bureau of Labor Statistics building operations as indicated by building permits issued involved a greater expenditure of actual money in 1920 than in the previous six years. The data were collected for 1919 and the previous five years by the United States Geological Survey and during 1920 by the Bureau of Labor Statistics. For most of the cities the information for 1920 was obtained from building inspectors of the different cities by correspondence. In a number of instances, however, the agents of the bureau obtained the information in person either from tabulated records kept in the building inspector's office or direct from the building permits.

The total value of building as revealed in building permits for 1920 was $1,318,992,872 as against $1,235,548,397 in 1919. For the previoous five years the figures were as follows: 1914, $736,758,492; 1915, $764,149,180; 1916, $963,384,664; 1917, $636,919,123; and 1918, $395,016,535.

In this tabulation 126 cities were included for 1919 and 1920, Greater New York being considered as one city. Of this number seventy-seven showed an increase in the cost of buildings as shown in the permits, and forty-nine a decrease. The greatest relative increase in cost of construction in 1920 over

1919 was in Charleston, S. C., where 251 per cent was recorded, while the greatest relative decrease was in Dubuque, Iowa, where 67 per cent was recorded. Of the ten largest cities in the United States, New York, Cleveland, Boston, Baltimore, Pittsburgh and Los Angeles showed a gain over 1919, while Chicago, Philadelphia, Detroit and St. Louis showed a loss. According to the information gathered by the agents of the Bureau of Labor Statistics, building inspectors in most of the cities covered say there is a pressing need of more dwelling houses and that 1921 will be a record year for building operations of all kinds.

The greatest need, it is believed, is for housing construction, with public works a close second.

Specifications on Pumps and Motors for South Africa

Blue prints and specifications covering the contract for the supply and erection at Vereeniging, Transvaal Province, South Africa, of two vertical and two horizontal spindle centrifugal pumps and motors, with all accessories, and one 10-ton traveling crane have been received by the Bureau of Foreign and Domestic Commerce from Consul Fred D. Fisher, of Johannesburg. This material is for use in connection with the Vaal River scheme. The specifications may be examined by interested persons at the bureau's New York office, 734 customhouse, or will be made available at any district or co-operative office, says *Commerce Reports*.

Employment Drops 2 Per Cent During July

According to the report recently made public by the state industrial commission, working forces in factories in New York State were further reduced by 2 per cent during the month of July. Since March, 1920, there has been a total decline in factory employment of approximately 30 per cent, or about 450,000 workers.

Contracts Total $20,000,000

Contracts let during the past week, as reported in *Engineering News-Record*, totalled more than $20,000,000. Highway contracts were in excess of $6,500,000, and miscellaneous structures, about $10,000,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of August 4, the next on September 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.88	$3.50	−$4.20	−$2.88	$3.16	$4.10	$3.70	+$4.10	$5.00
Structural rivets, 100 lb	4.40	5.25	5.75	−3.88	5.20	4.25	5.50	−5.25	8.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.78	3.20	3.50	−2.78	3.18	3.97½	2.35	−3.75	4.25
Steel pipe, black, 3½ to 6 in. lap, discount	51%	52.65-5%	45%	−53½%	53.9-5%	36%	46.25%	47½%	5%
Cast-iron pipe, 6 in. and over, ton	48.30	43.33	57.50	−46.10	52.80	57.50	60.00	63.00	75.00
Concreting Material:									
Cement without bags, bbl.	2.60@2.70(del.)	2.75	2.80	2.17	2.41	3.10	3.09	3.10	2.75
Gravel, ¾ in., cu.yd	2.25	2.25	3.00	−1.80	2.00	2.50	2.25	1.50	1.50
Sand, cu.yd	1.25	1.35	2.50	−1.80	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.90 to 2.00	2.25	2.80	−2.00	2.25	3.50	2.25	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	−47.00	38.00	35.00	−49.00	−34.00	47.00	27.00	21.00	120.00
Lime, finishing, hydrated, ton	16.99	19.00	25.00	20.00	29.00	32.00	25.40	24.00	28.00
Lime common, lump, per bbl	3.99	1.50	2.75	1.65	1.50	3.10	2.25	2.75	15.00
Common brick, delivered, 1,000	18.40	10.00	12.65	−11.00	17.00	14.00	18.00	14.00	18.00
Hollow building tile, 4x12x12, block	Not used	.14	.13	−.0926	.092	.09	.12½	.11	.15
Hollow partition tile 4x12x12, block	−.1005	.14	.13	.07410	.092	.10	.14½	.12	.....
Linseed oil, raw, 5 bbl. lots, gal	.80	+.86	.97	−.84	−.90	−.96	−.96	.79	.84
Common Labor:									
Common labor, union, hour	.75@.80	.35	.....	1.00	.50	.50@.63½	.81½	.75	.....
Common labor, non-union, hour	.....	.20@.25	.35@.45	.40	.50	.37½@.50	.50@.55	.50	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45@50 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 300-lb. bbl.; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. bags. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.60 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime; white is $1.80 for Kelly Island and $1.60 for Sheboygan. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. **Dallas** quotes lime by the 180-lb. bbl. Steel and crushed stone are quoted f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Cement price is in Canadian funds, exchange with the United States being 14 per cent at present. Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment.

Changes Since Last Week

The steel situation is practically the same as last week, except that there seems to be less deviation from the official Pittsburgh schedule of $1.85 per 100 lb. for structural shapes, $1.75 for bars. Dallas reports a 10c. reduction on shapes in warehouse, mill delivery price being $3.10. Rivets and reinforcing bars are down 25c. per 100 lb. in Seattle, present quotations being $5.25 and $3.75, respectively. Chicago prices now compare with those in New York, with the black steel base for lap-welded pipe 53½ as against 58½ per cent.

Price changes in concreting materials are not numerous, but Chicago reports rather abrupt declines in sand, gravel and crushed stone. Trade in crushed stone is reported to have bettered considerably in New York, recently; a price lowering is promised as soon as towing charges are reduced.

The wholesale base price of lumber in New York is now $42 per 1,000 ft. bm., with the price to contractors about $5 higher. The Chicago base is $49, as against $55. Douglas fir is down $1 in Minneapolis, to $34. Direct mill shipments of long leaf yellow pine, New York, are: 6-in., 20 ft. and under, $40; 10-in., $44; 12-in., $46. So far as logging and mill conditions are concerned, the cutting of the last 30 days is no greater than that of the month preceding, with demand negligible. Mill stocks are satisfactory, and labor is plentiful, reasonable and efficient. The simple fact is that with lumber, as with steel, there is practically no market.